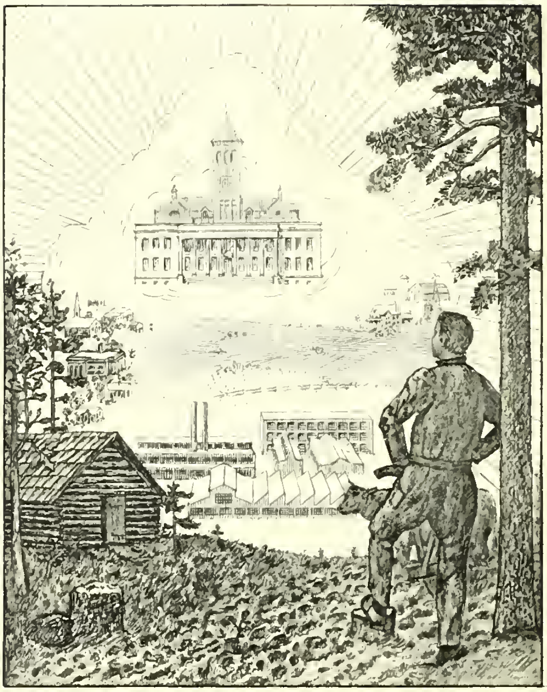
Clemson University
3 1604 013 348 802



CLEMSON COLLEGE LIBRARY

Digitized by the Internet Archive
in 2013

http://archive.org/details/annualreport19271943demm

Annual Report and Program
# of the
SOUTHERN FOREST EXPERIMENT STATION

January 1, to October 15, 1927

by

E. L. Demmon

Acting Director

STAFF OF THE EXPERIMENT STATION

Permanent Members

E. L. Demmon, Acting Director (since July 1, 1927)
L. Wyman, Associate Silviculturist
W. G. Wahlenberg (since April 1, 1927)
P. C. Wakeley, Junior Forester
L. I. Barrett, Junior Forester
E. W. Gemmer, Junior Forester (assigned to Florida Nat'l. Forest)
V. L. Harper, Junior Forester (since July 1, 1927)
Vera M. Spuhler, Senior Clerk
L. D. Vining, Superintendent of Naval Stores Field Station (Starke)
Mary C. Regan, Junior Operative
Hester C. Black, Junior Clerk-stenographer (since March 1, 1927)
Elizabeth Owen, Junior Clerk-stenographer (since Aug. 13, 1927)
Marie E. Turnbull, Junior Clerk-stenographer (since Apr.1, 1927)
(In cooperation with District Inspector.)

R. D. Forbes, Director (transferred to Allegheny Forest Experiment Station, July 1, 1927)
L. J. Pessin, Associate Forest Ecologist (resigned June 14, 1927)
Alicia P. Nolan, Junior Clerk-stenographer (resigned Feb. 1,1927)

Temporary Field Assistants

R. W. Hayes
G. C. Hoffman
W. W. Koch
L. D. Loyd
H. E. Ochsner
Eric Östlin
L. A. Sanders

RS
Investigations
Program

October 28, 1927

Annual Report and Program
# of the
SOUTHERN FOREST EXPERIMENT STATION
1927 *

General

Six years have now elapsed since the Southern Station was established in July, 1921. This is the seventh annual report to be made covering the progress of research at this Station and is the first one not to be prepared by R. D. Forbes, who on July 1, 1927, rounded out six years of service as Director of this Station, at which time he was transferred to assume the duties of Director of the newly established Allegheny Forest Experiment Station in Pennsylvania.

During the past six years the forestry movement in the South has rapidly forged ahead. The part which Mr. Forbes has played in the development of forestry in this great section can not be measured. For ten years he was one of the very few technically trained foresters working in this region whose influence has been felt in all lines of forestry work, and no small part of the progress made can be laid to his untiring efforts. For four years as State Forester of Louisiana, followed by six years in charge of the activities of the Southern Station, he has witnessed a remarkable progress in the development of forestry in this region. Of the nine Southern states, all or portions of which are included within the boundaries of the Southern Station territory, but one state, Texas, had an organized division of forestry before Mr. Forbes took the position of first State Forester of Louisiana in 1917. Since then, state forestry departments have been organized in each of the other seven states excepting Arkansas. Alabama created a forestry department in 1923, Georgia in 1924, Oklahoma in 1925, Mississippi in 1926, Florida and South Carolina in 1927.

Notable progress has been made in attacking the greatest obstacle to the practise of forestry in the Southern region, namely, forest fires, and especially so in those states where forestry organizations have been established for any length of time. Public opinion is coming to the realization of what the

*This report covers the period from January 1 to October 15, 1927.

The establishment of any further branch stations in addition to those at Bogalusa, Urania, Starke, and Camp Pinchot, should await the time when it will be possible to have someone in permanent residence not only at Bogalusa and Urania but at any new stations as well. It is our opinion that for satisfactory protection of experimental plots and for the purpose of assisting in the necessary supervision, someone should be in continual residence at these centers of work.

During the last year, the routine work of reexaminations and annual burns of the various permanent plots at Bogalusa and Urania has not taken up more than one-half of any one man's time and as a general rule considerable periods of time elapse when no one is at these substations.

Consideration of possible locations for new branch stations is always kept in mind and our territory is being studied at every opportunity with this in view. One of thepurposes of the extensive surveys has been to look over the possibilities which different places offer for suitable branch stations. The forest association map for the South which has recently been prepared, will be found very helpful in showing us the extent and importance of the various pine and hardwood types and in the choice of centers from which field work can be carried on to the greatest advantage. However, there seems to be no need of deciding on points for the location of additional branches until such times as the permanent staff is again up to its full quota and the work that has already been started is well under way.

Allotment

The allotment for the fiscal year 1928 is $41,290, an increase of approximately $2500 over the amounts available during each of the preceding three years. This increase has come about through legislation passed by the last session of Congress through the efforts of Senator Fletcher, whereby $5,000 was made available for additional research work on naval stores. Approximately half of this amount has been apportioned to the Forest Products Laboratory for research into gum production, while the other half is being used by the Southern Station to further the work at Starke. This addition has permitted us to employ a Junior Forester to assist Mr. Wyman in the investigations of yield of gum and chipping methods.

Although the work of Mr. Gemmer, the technical forester working at the Camp Pinchot, Florida, branch, is being supervised by the Southern Station, his salary is being paid from administrative funds provided by the Eastern District of the Forest Service.

Personnel

In the transfer of Director Forbes, which transfer family affairs made necessary, the Southern Station has suffered a loss which it is impossible to estimate. Due to his intimate knowledge of every line of Station activity with each of which he has been so closely associated during the past six years, or since the Station was established, his advice will be sorely missed. The fine spirit of cooperation evidenced by the remainder of the staff has already gone a long way in successfully continuing the program of work which had made such auspicious headway under Mr. Forbes' direction.

The Station considered itself fortunate in obtaining the services of a forest ecologist, Dr. L. J. Pessin, who, during his seven odd months with us, proved to be of great help in the consideration of a number of our problems, especially by reason of his intimate knowledge of the basic natural sciences, gained through careful individual research and study over a considerable number of years. His resignation to accept the position of Plant Pathologist at the Texas State Agricultural Experiment Station was a severe loss. That another man of his training and ability, particularly if he were trained in soils, would be a valuable addition to the Station is the view expressed by all the staff who worked with Dr. Pessin.

On April 1, 1927, the permanent staff was for the time being brought to its full complement of seven technical members, through the transfer to us of Assistant Silviculturist W. G. Wahlenberg from Montana. He brought with him valuable experience and an excellent background for investigative work gained through eight years in nursery and planting practice at the Northern Rocky Mountain Forest Experiment Station.

The Junior-Clerk vacancy caused by Mrs. Nolan's resignation was filled by Mrs. Black. By the cooperative arrangement with District Inspector Evans, the Station obtains part time services of an additional Junior-Clerk, Miss Turnbull. Considerable temporary clerical help, amounting to 32 continuous weeks, has also been employed in order to bring office work up to date.

Some additions in personnel have been made at Starke, largely through the additional funds provided for naval stores research. Junior Forester V. L. Harper, a recent graduate of the University of California forest school, reported on July 1, 1927. A Junior-Clerk, Miss Owen, was appointed in August, and on October 1, L. D. Vining filled the newly created position of "Superintendent of Naval Stores Field Station". His appointment will relieve the technical staff of considerable supervision of the routine work of chipping, dipping, etc.

During the period under report, 18 man-months of temporary technical help has been employed, mostly men in training for permanent positions who are obtaining additional experience in actual forestry work. Most of these men returned to various forest schools for additional training.

The vacancies caused by the transfer of Director Forbes and the resignation of Dr. Pessin have not as yet been filled.

Forest Schools

The lack of suitably trained foresters in the South is in part due to a lack of adequate forest schools. At the present time, with the development of forestry in the South and the growing appreciation of the need for putting our land to work, there is a demand for foresters that the technical schools throughout the country cannot supply. These men, unfortunately, are for the most part from the North, with exceedingly limited Southern experience, if any. With the very great area of forest land now in the South, a large part of which will undoubtedly remain always as forest land, there is going to be need for a great number of technically trained men who will have as good a training in forestry as can be had at any of our institutions. The South for many years has provided wood products for the development of the nation and in this way has furnished a large basis for the prosperity of the country. In view of the situation regarding our forest land and our forest schools, it is believed that some definite and concrete action should be taken looking specifically toward building up, when we can, our Southern institutions.

Because of the start already made at Louisiana State University, it is believed that its forest school affords an excellent opportunity for such an institution of the highest caliber. At the present time the staff of the Louisiana forest school numbers three men, and in our judgment there should be at least double this number, and these men should all be recognized authorities in their particular branches. Louisiana State Forest School has now an excellent building and equipment but needs additional personnel. The loss of much taxable forest wealth, the exhaustion of the sulphur mines, and the exceedingly great economic loss sustained as a result of the flood of 1927 all appear to make it necessary that outside help be invited to put the school upon an adequate basis.

A somewhat similar situation exists in Georgia, but with less general interest on the part of the school authorities, with a poorer plant, and with inadequate equipment. The needs are therefore greater and much more effort is needed to place the school on a stable foundation. With the development of the second-growth forests, and with the heavy production of naval stores in the southeast, it appears desirable that something should be done there also.

Other states in the South are giving some attention to forestry training in the secondary schools, but we are here concerned primarily with the problem of the technically trained forester.

It is suggested, therefore, that the Council devote a considerable portion of its efforts during the next year to seeing if there may not be some way by which the schools can be placed upon a sound basis. To our minds it would appear that endowments are the only way to meet the situation. It is believed that a number of chairs of forestry should be established under such a plan, and it is recommended that an attempt be made to obtain the necessary funds in large part from the lumber industry of the South, including both pine, hardwood and cypress. Many men have made their fortunes from the forest industries in the South, and it seems only just that they should assist in building up through the education of foresters, the land resources from which they have derived their wealth. A canvass of the situation should probably be first made to determine the needs of these schools, how much of an endowment may be necessary, and what sources of interest may be enlisted in carrying out such a proposal.

The suggestion that the Louisiana institution be selected as the one upon which attention should first be devoted in no wise reflects upon any other schools in the South. It is felt that the University with its present equipment and personnel is, of the schools now existing, perhaps in the most strategic position to go forward at the present time. The Louisiana School is central to a large part of the South and undoubtedly should be able to draw upon all portions of the Southern pine region for its membership. However, this whole subject should be very carefully looked into and recommendations and suggestions made to the Council.

Cooperation

The Station is fortunate in the continued cooperation of a number of timber and landowners at the various branch stations, among them the Urania Lumber Company, the Great Southern Lumber Company, L. G. Powell and R. H. Smith. The heartiest cooperation has also been received from such other agencies as the Bureau of Plant Industry and the Bureau of Entomology in the way of identification of specimens and obtaining advice relative to forest insects and diseases; from the Coastal Plain Experiment Station at McNeill, Miss., in the supervision of our experimental work there; from the various state universities in Oklahoma, Texas, Louisiana, Georgia, and at Cornell, in conducting pine seed germination tests; from the Yale Forest School in the preparation by the forestry students of a topographic map of the Greeley Pasture at Urania; from Tulane University in allowing us to make use of their laboratory and equipment; from the various state and extension foresters of the Southern States who have furnished much valuable information incorporated in the report on "Timber Growing and Logging and Turpentine Practice in Southern States"; and from a number of members of the Forest Service of the Eastern District, the Washington office, including particularly Dr. A. Cary and W. M. Mattoon, and from the Forest Products Laboratory.

The experience gained in two years of extensive surveys in various parts of the South was placed at the disposal of the Appalachian Forest Experiment Station when Demmon spent 10 days in assisting a crew from that Station in getting started on similar surveys in the Coastal Plain region of Virginia and North Carolina.

At the beginning of the calendar year a cooperative project was worked out between the Florida National Forest and the Experiment Station. Under this arrangement the full time of one man in the administrative organization of the Forest Service is to be devoted to research on various phases of forest management under the general direction of the Experiment Station. This assignment, the first of its kind in the eastern United States, practically increases the research being done on the pine problems of the South by the time of this man. Although the problems upon which he is working deal largely with questions which relate definitely to the management of the Florida National Forest, they have a decided and practical bearing upon related problems extending over a wide area in the longleaf pine region. This very desirable form of cooperation affords a most welcome and highly satisfactory tie between the research and administrative branches of the Forest Service.

In addition to this work, the Forest Products Laboratory is undertaking on the Florida Forest a detailed study of the relationship of environmental conditions upon the growth properties of wood. This work, under the direction of B. H. Paul and Dr. A. Weinstein, began early in the year and continued throughout the summer. The Southern Station's part in the general project has been to assist in all possible ways.

As a general part of the above project, the Station has also arranged for a visit to the Florida Forest by Dr. Freeman of the Office of Forage Crop Plants in the Bureau of Plant Industry, that he might give some help to the Station through his knowledge of leguminous plants. It is hoped that he will be able to find some legume growing naturally in the South which has possibilities both for soil improvement and for forage. If this develops it may be feasible to work out a method of increasing the productivity of forest land through legume production. Dr. Freeman plans to visit the South some time during the coming few months.

Very close cooperation also exists between the Forest Products Laboratory and the Station, in the investigations upon naval stores. In fact, this is a tri-partite arrangement in view of the work that Dr. Cary is also doing upon similar problems. The Southern Station has been furnishing Dr. Gerry of the Laboratory with specimens of chips from various trees for her microscopic studies of structure.

In previous years attention has been directed to the fact that practically no work is beind done in this vast region upon the diseases of our forest trees and woods. It is possible that funds sufficient to assign one man to studies of our forest tree diseases, and perhaps one man also upon the study of the decay in Southern wood products may this year be provided. This, however, is not yet assured.

Similar representations have been made also in times past as to the need for the assignment of a forest entomologist. So far nothing has materialized in this direction, although the need for this work becomes all the more important as time goes on.

It is also becoming evident that the South is in need of a specialist to consider detailed problems of wild life management and forest development. The increased interest in late years in wild life and in game preserves is adding an additional factor to our forest management. Thus we find biologists and foresters at variance regarding such things as the effect of burning upon the food and reproduction of game birds and animals. In many places throughout the South wild lands are being devoted to fur farms of one kind or another, and there seems to be no reason why it should not be possible to combine on many areas the production of both fur-bearing animals and forests. Recently also in northern Louisiana there has been a movement for the establishment of wild life sanctuaries, and we should know more about the effect of cutting, floods, and the changes in forest composition upon the food habits and behavior of our forest wild life. It is, therefore, suggested that the advisability of assigning a forest biologist to the Southern Station be taken up with the Biological Survey.

State Cooperation

The most recent plan whereby cooperation will be afforded to the Station is in a proposed study in Southern hardwoods. This work will be undertaken at the instance of the State Foresters of Louisiana and Mississippi, each of whom has agreed to detail a technically trained forester to work on this project, under the direct supervision of the Southern Station. Although the plans for this work are as yet indefinite, it has been suggested that before any intensive studies are begun, a general broad survey be made of the hardwood region in the two states of Louisiana and Mississippi with the idea of obtaining a more comprehensive view of just what is most needed. This development indicates the desirability of the Station undertaking shortly hardwood investigations. To this end, increase in Station funds will be necessary as our present funds are obligated for pine studies.

Public Relations

Staff members have attended a number of meetings throughout the year; Wyman, the Pine Institute, Southern Forestry Congress, Florida Turpentine Producers' Association, and a meeting of naval stores operators at Waycross, Ga., at all of which gatherings he talked on various phases of naval stores research.

Forbes attended meetings of the Association of Agricultural Editors and the Southern Pine Association.

During Forestry Week last spring, various members of the Station staff gave addresses and prepared articles for the press.

The Station headquarters and several of the branch stations have been visited during the year by a great number of people interested in obtaining information which the Station may be prepared to give. There have also been a number of scientists, among them various specialists from other countries, who have heard of the Station's work and have stopped in to confer on those subjects in which they are chiefly interested.

Investigations

Jan. 1 - Oct. 15, 1927

Special Flood Study

At the request of the Forester, the Station cooperated in the compilation of information that would assist in the study of the relationship of forest cover to flood and erosion control in the Mississippi River drainage basin. About two full months time of the Station staff were given over to this work.

Although this flood study interfered seriously with the regular work, it proved of immense value to the Station. It served to bring our attention most forcibly to the hardwood types which until now have been given little consideration in the Station program because of the greater extent and importance of the pine types in the territory served by the Southern Station. The systematic analysis of all available data pertaining to forest, soil, physiographic, climatic, and economic conditions covering the vast area assigned to us in this study has given us all a much clearer picture of certain parts of our territory than we have ever had before.

The region assigned to the Station included the basins drained by the Lower Mississippi River and the Ouachita and Red Rivers, covering in total an area of about 150,000 square miles. Detailed reports were prepared for a number of minor as well as for the two major drainages, and the discussion included information on topography, soil, climate, historical development, the amount and condition of improved, unimproved, and forest land, the effect of lumbering, fire, grazing, and drainage, an estimate of the protective value of the watershed from an erosion and flood flow standpoint, a discussion of critical areas or those areas where forests might or do now exert a maximum protective influence, and recommendations for each watershed as to the area that should be retained in forest and the measures necessary to keep present forest land productive.

The results of the flood study have been assembled in Washington and will be correlated with reports of other agencies in future considerations of flood control.

It might be mentioned that within the territory assigned to this Station for study, a number of individual areas were found where forest cover exerts an important protective value. Among these could be mentioned in particular the hill region in the Upper Yazoo, Big Black, and Homochitto river drainage areas in the Bluff country of western Mississippi, the Tunica Hills and Kisatchie Hills in Louisiana, the Ouachita and Ozark Mountain region in Arkansas, Oklahoma, and Missouri, and the "Breaks" in Texas and Oklahoma.

In some of these districts, the most productive use of land can be looked for only through improvement in current agricultural practices, replanting of denuded areas, protection from fire as well as from excessive grazing and other agencies, and proper methods of forest management. These can best be obtained through the encouragement of better agricultural and forest practices, through systematic education, and in some localities by the establishment of state, national, or municipal forests.

Forest Associations

A forest association map for the Southern region which was originally prepared last year by Demmon has undergone considerable revision through the cooperation of a considerable number of foresters throughout the South to whom it was sent for comments. The corrections were included in a revised map and copies of this have been furnished to a considerable number of foresters throughout this region whom we believed were in a position to check up on the accuracy of the type boundaries. At some future date it is proposed to have a final map prepared which will then contain the fullest information obtainable on this subject and it will then be made available for general distribution.

Fire Studies

The importance of having concrete information on the effect of forest fires is apparent to everyone at all familiar with the lack of definite knowledge existing concerning this greatest single enemy to the successful practice of forestry in the South today. Studies of fire damage in the pine region are therefore placed first in importance amongst the various lines of work undertaken by the Station. Permanent sample plots for the study of fire damage have already been established at several points in the South. Current seasonal burns on these various fire plots located at Starke, Urania, McNeill, and in eastern Texas have been made providing conditions were found to be favorable at the time burning was attempted. If conditions were unfavorable for obtaining a fairly complete burn, no extreme measures were taken to burn over a plot. Instead, it has been our intention to approximate the effects of fire in the locality in which the plots are located. For this reason, the longleaf plots will occasionally miss a seasonal burn, while with the other species two or even three seasons may elapse between fires. The first five-year remeasurements of the permanent fire plots in loblolly pine at Urania are scheduled to be made during the coming field season and these should provide valuable material for the bulletin on "Forest Fires in the Southern Coastal Plain".

Measurements

Of outstanding importance during the last year has been the completion of the manuscript to accompany the volume and yield tables for the four species of second-growth Southern pines. This manuscript is now in the hands of a board of review and will probably be published and available for distribution some time in 1928. In the meantime, the more important tables have been mimeographed for limited distribution to those most likely to make use of them. These preliminary tables are accompanied by a brief description of methods for their application in the field. It is specifically pointed out that these volume and yield tables are not applicable to understocked stands and that a considerable amount of additional investigation is needed before their application to other than fully stocked stands is understood. In this connection it is planned to establish a number of permanent yield plots in understocked stands and under varying conditions so as to observe their approach toward normality over a period of years. The application of the tables to stands in several localities in the South in cooperation with a number of progressive lumber companies is also contemplated.

The Station was very fortunate in obtaining the services of a Swedish mensuration expert and student visiting America under the Scandinavian-American Foundation, Mr. E. Östlin, who spent about two months upon one phase of this work, namely, a study of tree growth following cutting. From the analysis of very complete measurements of 50 trees on some cut-over longleaf pine land near Urania, it appears that there exists a remarkably close coincidence between the volumes of the trees according to the Swedish form classes and their actual measured contents. Although the form class appears to decrease slightly following cutting, the accelerated increment is far from being confined to the lower part of the tree. In other words, the advisability of using breast-height diameter measurements in estimating volumes of trees left for increased growth, will be determined by this study which, however, will be checked later by duplication in other pine species and in different parts of the South.

Management

There has been no opportunity to carry through the program of extensive surveys planned for the past year but this has merely been postponed until the staff is again at full strength. Field data taken in former surveys still remain to be worked up in the office and it is planned to complete their analysis before any additional surveys are started.

A number of postponed field measurements in connection with our management studies have been largely brought up to date during the past few months through the assistance of Professor R. W. Hayes of the Louisiana State University forest school, who was attached to the Station staff for a period of about eight weeks during his summer vacation. This marks the second time that we have availed ourselves of the opportunity of employing Professor Hayes for limited periods of time.

The establishment of a number of management projects on the Choctawhatchee Branch in Florida was preceded early in the year by an intensive study of the silvicultural problems, made by four members of the Station staff who spent several weeks in that vicinity. A very comprehensive working plan listing a considerable number of proposed studies has been prepared by Mr. Gemmer, detailed to take charge of the silvicultural investigations at that Branch.

Taking advantage of the good longleaf pine seed crop which occurred this year in various localities in the South, studies of the relation of size of tree to cone crop were made. Cone counts taken in Southern Mississippi on about 1500 longleaf and slash pines left in logging over 20 years ago showed that for seed trees up to about 20 inches in diameter the number of cones per tree increases with the diameter of the tree, while beyond that point the cone crop decreases.

The effect of site on seed production was also worked up for this same locality and it was found that for trees of the same diameter, those growing on the better soils showed a larger production of cones than those on less fertile soils.

The results of the second five-year remeasurements of the thinning plots that were established at Urania in 1915 were worked up this year. Although the handling of these plots in the past has left much to be desired, some results are already apparent from a comparison of the volume growth of the trees on the thinned with the unthinned plots. The data reveal that light thinnings have little effect in accelerating the growth of the trees left, but a considerable increase in growth rate follows heavy thinnings. Where a market for pulp wood is to be had, the yield in cordwood from heavy thinnings will prove profitable. The results also indicate that for shortleaf and loblolly pines growing on average sites, the best thinning practice is probably to thin heavily at 10-year intervals, beginning when the stand is about 20-years old.

The preparation of the manuscript for the bulletin on "Timber Growing and Logging and Turpentine Practice" occupied the greater part of Mr. Forbes' time during the greater part of this year. In this he was assisted by the entire staff not only in the compilation of data in the office but through special field trips to obtain additional information. This manuscript covers the results of many of our studies and experiences in the South and indicates those general practices which should be used to keep our forest lands fully productive.

This bulletin, which undoubtedly represents the most important piece of work yet put out from the Southern Station, will probably be available some time in 1928. It is planned to obtain a large edition of this paper for general distribution throughout the southern pine region.

NAVAL STORES

General

No new work was started in naval stores during the year 1927, but all tests which were under way in 1926 were continued through this year. Two groups of trees which were used for a yield table study in dense stands of slash pine were rested during 1927 and will be chipped for back-box yields, one group during 1928 and the other in 1929. During the year 1927, about 3900 trees were being worked in our experimental areas.

Methods of Chipping

The tests of height of streak, depth of streak and width of face were carried on throughout the year, and for the first time the narrow chipping showed a decidedly larger yield than the wide chipping group. This difference amounts to approximately eight barrels of spirits per crop, in slash pine. The longleaf pine tests, however, showed no advantage for the narrow chipping, which may have been due to the difference in quality of the trees used in this part of the tests.

The shallow chipping has had a high sustained yield, and the deep chipping, one inch deep, continues to decline in yield.

During 1928 a depth of chipping test in slash and longleaf pine will be started in young round timber in the vicinity of Lake Butler, eighteen miles west of Starke. Four depths will be tried and there will be two hundred trees to a group, a total of eight hundred slash and eight hundred longleaf, or sixteen hundred new faces. The purpose is to determine the effect of deep chipping in a different type of timber than the one in which we have been working. These trees can be worked directly from the Starke branch.

There is a continued loss due to wind-break and dry-face in the group of slash trees which had two faces, where 75 per cent of the bark was removed. The yield from this style of work and from the wide faces covering 50 per cent of the bark perimeter continues to decline and now the yield from the 75 per cent width of face group amounts to only 24 per cent more than the single face group, and the wide faces have been yielding 16 per cent more during the year 1927. All of these trees will be abandoned at the end of this year, which is the fifth year of work. In 1927 three groups of 190 trees each in longleaf pine were included in width of face tests with 25 per cent, 33 1/3 per cent, and 37 1/2 per cent face widths respectively. In 1928 the width of face test will be carried on in 50-tree groups of slash pine with face widths of 25 per cent, 33 1/3 per cent, and 37 1/2 per cent respectively. In longleaf pine the same groups which were used in 1927 will be used again in 1928. The effect of chipping upon rate of growth will be worked up during the year 1927 for all these groups which were started five years ago.

Width of face tests of 200 trees each with standard width and narrow faces will be established at Lake Butler in slash and longleaf pine. Also on the Florida National Forest groups of standard and narrow faces will be established in a longleaf stand. The standard width of face groups will be duplicates so the total number of new faces in this test will be 600, 400 longleaf and 200 slash.

Gum production in relation to size of tree, density of stand, etc

Two hundred twenty-two slash pines were divided into diameter classes, and the gum from each class weighed separately, the material being used for a yield table. This represents the third year of work on these trees, and yields will be obtained from them during 1928 and 1929. In addition 150 slash pine second-growth faces were included in a yield table study and the gum from each of these trees was weighed separately. In longleaf pine, 217 trees were divided into diameter classes and the gum from each diameter class weighed separately, the figures to be used for a gum yield table. This is the second year of work on these trees, and yield table material will be obtained from them for three more seasons. Gum yield tables combining the yield from second-growth slash for the first and second year of work and for longleaf from the first and second year of work on two different sites were worked up and included in an article submitted for publication in the Yearbook of the Department of Agriculture for 1927. This table follows:

Table I.

Naval Stores Yields From Open Grown Slash and Longleaf Pine

Diameter of tree in inches $4\frac{1}{2}$ feet above ground	Average Seasonal Yield			
	Barrels of spirits per crop		Ounces of gum per fa (dip and scrape)	
	Slash	Longleaf	Slash	Longlea
5	11	--	37	--
6	17	--	56	--
7	22	13	74	51
8	28	18	93	69
9	34	23	112	86
10	39	27	130	104
11	45	32	148	122
12	50	37	166	139
13	56	41	185	157
14	62	46	204	175
15	68	51	223	193
16	73	--	241	---

Note: This timber is located in Bradford and Clay Counties, Florida. Trees ranged from twenty to forty years of age. Only one face was placed on a tree, regardless of size. Streaks were one-half inch wide and one-half inch deep. Thirty streaks constituted a season. Slash figures are for first, second and third year work, longleaf for first and second year work.

Two hundred trees each of slash and longleaf at Lake Butler will be used for yield table material. Probably they will be the same trees that will be used in one part of the depth of chipping test. Also at Slidell, La., a 200-tree group of slash trees will be used for yield table material, to be handled from New Orleans, and 200 longleaf will be worked on the Florida National Forest to obtain material on relative yields from different regions and soil types. These will probably be handled by the technical assistant at Camp Pinchot, who will also have charge of the depth of chipping and width of face tests on the Florida Forest.

Gum production in relation to environment

The daily yield of gum from 70 longleaf trees and 37 slash trees was obtained and correlated with weather and soil factors. The trees used in this test were worked continuously from May, 1926, to October, 1927, and show the effect of this continuous work without a rest period. Therefore records from these trees will be discontinued, and a new group of 70 longleaf trees will be substituted for the old ones and worked for at least a twelve-month period. No figures on this test are available at this time. It will not be possible to substitute any new slash pines in this test because there are none available at the location where the weather instruments are established, and funds do not permit the duplication of weather instruments in slash pine and longleaf pine stands.

Forestation

The Station's files now contain upwards of five years' accumulated notes on seed collection, extraction, testing and storage, on nursery practice, and on seeding and planting in the field. Work in the field during the past year has completed several of these sets of notes or brought them to a point where a very brief additional field study will complete them. Compilation of these notes is proceeding simultaneously upon the results of the seed extraction studies, germination tests, storage tests, nursery experiments, and studies of plantations, the results of each line of work frequently throwing light on puzzling points in the others.

A one-acre plantation was established to test the quality of stock produced by loblolly seed from four different regions, the Georgia Piedmont, southwestern Arkansas, eastern Texas, and eastern Louisiana. Record was also made of the sources of seed for all the commercial plantings of the Great Southern Lumber Company, which thus give us some twenty square miles from which to select plots for the study of seed from different regions.

Small amounts of Southern pine pollen were collected and sent to the Eddy Tree Breeding Station in California for experiments in cross-breeding commercial species.

In a test of chemical control of weeds in the nursery a 4' x 160' commercial bed of longleaf pine, in the Great Southern Lumber Company's nursery at Bogalusa, was treated with eight grams of zinc sulphate per square foot. The zinc sulphate materially decreased the weeds in the treated bed, except for grass starting from roots already in the ground, but the treatment was evidently slightly in excess of the desirable amount and caused a higher mortality in the pines than was expected. Results of the test will be available when the seedlings are lifted for planting. It is understood that the cost of weeding was very greatly decreased.

A half-acre plantation of Sonderegger pine, the hybrid between loblolly and longleaf, was made at Bogalusa from stock obtained in the Great Southern Lumber Company's nursery. This hybrid has shown itself unusually vigorous but unfortunately seems to be attacked by every animal, insect, and disease attacking either parent. At present the plantation is nearly defoliated by needle blight and is also heavily infested with tip moth.

Spring sowing of longleaf, slash, and Monterey pine seeds in prepared spots at Bogalusa was tried out on the theory that fall sowings had failed because birds ate the seed and that spring migrations would take so many birds north that sowing would be a success. Despite the decrease in number of birds, however, practically every seed was eaten within a week.

In February, 400 two-year-old longleaf seedlings were planted in the deep, coarse sand of the Choctawhatchee Division of the Florida National Forest. Through unavoidable delay, the work was not done until most of the seedlings had started new growth, and this fact, combined with the sterile soil and an unusual drought, resulted in the loss of most of the plantation. The survival of even a few trees under such unfavorable conditions, however, is encouraging. The plantation was supplemented by direct seeding in prepared spots and although the longleaf seed germinated extremely well, the resulting seedling were promptly destroyed by black ants. Here is a hitherto unsuspected factor affecting reproduction on the Florida National Forest.

Data on our experimental plantations have been put on punch cards and from preliminary trials in the analysis of this information by means of a sorting and tabulating machine in Washington, the indications are that we shall be able to isolate to a greater or less degree the effects not only of season and method of planting, as was originally the purpose of the study, but also effect of soil, rabbit injury, tip moth injury, rust, needle-blight, proximity of stumps, washing of soil, density of grass cover, previous burning of area, and a number of other factors.

Supplementing our own planting experiments are the results of extensive examinations made by Professor Hayes a year ago in the Great Southern Lumber Company's plantations. His figures on height were based on more than 4,000 trees, while his study of mortality covered something over 22,000 trees. A preliminary report of the results have been made and the facts most clearly brought out were the vast superiority of longleaf over slash on the ridges together with the increase in both height growth and survival of slash pine with approach to its natural site on the flats. Tip moth infestations were so serious on loblolly that no definite conclusions could be drawn concerning this species except the superiority of nursery to wild stock. Rabbits caused the most serious damage to slash pine, and, after tip moth the most serious to loblolly.

Because of the fact that so much past data await analysis, few new forestation studies are contemplated for the coming year. The scarcity of longleaf pine seed years emphasizes the need for determining some method of storing seed of this species and some few such tests will be started shortly. It is planned to repeat the treatment which has given the best results so far, storing seed sterilized with formaldehyde in sealed and sterilized glass jars. In addition, we will try cold storage, storage of seed sterilized with a commercial powder called semesan, and storage in moss moistened with salicylic acid.

Control of weeds by application of chemicals will be tried out on seed beds of longleaf pine at Bogalusa, in cooperation with the Great Southern Lumber Company. Application of formaldehyde prior to sowing, together with a moderate zinc sulphate treatment later, will be tried out in attempting to kill both the roots and seeds of grasses.

Last year's experimental planting on the Florida National Forest at Camp Pinchot will be repeated again this year, using year-old nursery stock. A nursery will also be established at Camp Pinchot, using locally collected seed, this to serve as a basis for further experimental plantings in the deep sand country in Florida.

Grazing

The very comprehensive study of the relation of cattle grazing and annual burning of forest lands to longleaf pine reproduction now being carried on in a longleaf pine cut-over area in southern Mississippi, was the subject of a progress report. This report presents the results of a detailed study of survival of seedlings with varying fire and grazing histories. On four areas, each of which represented certain combinations of conditions, survival of longleaf pine seedlings for the first three years of their life amounted to 85 per cent on areas protected from fire and grazing; 75 per cent on areas grazed but protected from fire (excepting in carpet grass, where the mortality was high); about 18 per cent on the burned and ungrazed plot, and 56 per cent where both fire and grazing have occurred. The fires were typical winter burns and the cattle were grazed at the rate of one head to 10 acres.

Seedlings coming in on areas of advance reproduction and under seed trees showed very low survival. Heavy grazing on sedge grass and wire grass areas has resulted in such a reduction of hazard on the burned areas that survival of pine seedlings has remained high, even under conditions of annual fires. Unless fires can be completely eliminated, it appears that some grazing will be found beneficial to reforestation, excepting only on carpet grass areas.

The possibilities for additional studies on this area are excellent and already plans are being made to make observations that will lead to a better understanding of the problems of natural seeding and reproduction of longleaf pine.

Proposed Work

Oct. 16, 1927 - Oct. 15, 1928

No expansion of our present program will be possible during the coming year nor is any expansion recommended until the results of past field work are brought nearer to completion. This state of affairs has come about from a number of causes, chiefly through changes in personnel, which has resulted in unfamiliar work being thrown upon new members of the staff, with resulting loss in time and efficiency. The two months devoted to the flood study also cut into regular work and delayed several jobs outlined for completion during the past year.

Current work on all permanent sample plots will be continued regularly as required. The extensive surveys should be continued whenever time is available, as their value in helping to familiarize the new members and those yet to be appointed to the staff with the region is distinctly recognized.

The specific jobs which are planned for the coming year, arranged in the order of their importance, are the following:

1. Preparation of a bulletin, "Forest Fires in the Coastal Plain". This will summarize all data on effects of fire which have been taken in the course of the extensive surveys during the last three years. All other available sources of information will also be utilized, making use of the manuscript prepared by Forbes in 1922 on this subject.

2. The preparation of a comprehensive progress report through the compilation and analysis of the data obtained during the last five years on naval stores investigations at Starke is planned. This will summarize the results of our chipping method studies, the work done in yields, and the damage done by improper naval stores practice. Upon this work, Wyman will devote a considerable part of his time during the coming year.

3. The preparation of a manuscript covering the results of five years' investigations in forestation work is proposed and plans for further field work will await the analysis

of the data already obtained. The only exception to this will be the conduct of tests on methods of storing longleaf pine seed and an experiment in weed control, in cooperation with the Great Southern Lumber Company, neither of which will require any great amount of time in the field. The Station is being asked continually for the results of its work, particularly in view of the great interest now being taken in reforestation by states and by landowners generally.

4. How natural reproduction may be obtained on the deep sands of the Florida National Forest is the problem which can be answered only by the carefully planned and thoroughly carried out experiments such as are contemplated at the newest branch station. A proposed working plan has been prepared and some studies have already been started. Final approval of the plan as now outlined awaits a conference of representatives of the Station and the Eastern District, on the ground. It is planned to hold this conference some time in November and the progress of the work will thereafter be very carefully followed through regular visits from the Southern Station staff, each of whom will be asked to contribute towards the solution of what is probably the most difficult silvicultural problem in the South.

5. Now that the preliminary volume and yield tables for second-growth Southern pines, with a brief explanation of their application, have been made available, steps should be taken to see that those chiefly interested in making use of them are able to do so. Before the full value of these tables can be utilized, their limitations should be checked by trying them out under varying site and local conditions, in a great number of localities throughout the South. It is planned during the coming year to have some one from the Southern Station visit several of the progressive lumbering operations in the South, especially those where the owners have stated their interest in perpetuating the industry in their localities and cooperate with them in trying out the new tables in the field.

6. It is planned to establish a number of permanent yield plots in stands of each of the four Southern pines and under varying site and degrees of stocking conditions. The application of normal yield tables to understocked stands can be made possible only after a very thorough study of the development of such stands, and that is what is expected from such yield plots.

7. The analysis of the measurements made at Urania for the study of accelerated growth of trees left in logging should be completed during the coming year. The results of this study will give us definite information of the value of breast height diameter measurements in judging volume increase in trees left for a second cut. The results of this study will be checked in other localities and with the other species of pine before final conclusions are drawn. Methods of procedure worked out in this initial study will serve as a standard for the others to come later.

8. It is also proposed to enlarge the present naval stores program to include studies of gum yields and methods of chipping slash and longleaf pine at other points in the Station territory: at Lake Butler, near Starke, near Camp Pinchot on the Florida National Forest and at some point near Bogalusa. This will duplicate part of the work already under way at Starke and should serve to bring out differences which may be due to variations in climatic and soil conditions.

9. The answer to the question "What is a seed tree?" will require a great amount of further study. Some information is already being taken currently on a number of our permanent sample plots but every opportunity to obtain additional information on this very important question will be taken. Extensive surveys offer an excellent means of gathering a considerable amount of information on this subject, through classifying trees according to the number of cones borne during seed years by trees of varying sizes and descriptions, by determining the distance to which seedlings have become established when the source of seed is known, by correlation of numbers and kinds of seed trees with the reproduction found on the ground, and studies of a similar nature.

10. A number of experimental thinning plots will be established in a variety of localities and with different degrees of thinnings. The cooperation of the state extension foresters in the Southern states will be sought in the establishment of these plots, which will also serve as demonstration areas. The shortcomings of some of the former thinning plots have been brought out in the analysis of the data taken at Urania, and the experience gained from them will serve to make the results from any new plots of greater value to a clearer understanding of this subject.

Progress on some of the proposed work listed above will depend on the length of time taken to bring the staff up to full strength. As soon as this has taken place a considerable amount of time now taken up with administrative duties could be put in on the proposed field work. The extensive survey program will also be deferred until the present vacancies on the staff have been filled. Important as they may be, studies of hardwood problems, erosion, adaptability of slash pine to various sites, and investigations of forest tree diseases and insects are not recommended until further financial support is made available.

Distribution of Expenditures by Projects

Southern Forest Experiment Station

Fiscal Year 1927

- - - - - -

Project	Amount
Protection, fire	2973.46
Measurements	5087.21
Management	8035.78
Naval Stores	13046.80
Forestation	5187.28
Protection, others	3480.96
Miscellaneous	1028.51
	38,840.00

ARTICLES FOR PUBLICATION

a. Submitted Jan. 1 to Oct. 15, 1927

Forbes	"Volume, Yield, and Stand Tables for Second-Growth Southern Pines". Submitted for publication as a department bulletin. Feb., 1927.
	"Uncle Sam Helps to Solve the Southern Timber Growing Problem". Published in American Forest Week Section of *New Orleans "Times-Picayune"* and given wide distribution over the South. April 24, 1927.
	"Timber Growing and Logging and Turpentine Practice in the Southern Pine Region". Submitted for publication as a department bulletin. September, 1927.
Forbes and Demmon	"Preliminary Volume and Yield Tables for Second-Growth Southern Pines". Mimeographed for restricted circulation. August, 1927.
Demmon	"Fire Damage in Southern Pine Forest". Submitted to *Forest Worker*. October, 1927.
Wyman	"Naval Stores in the Practice of Forestry". Georgi State College of Agriculture *Cypress Knee*. March, 1927.
	"Naval Stores Research". Proceedings of *Ninth Southern Forestry Congress*. March, 1927.
	"Yield of Gum from Slash and Longleaf Pine". Submitted for publication in 1927 Department of Agriculture *Yearbook*. October, 1927.
	"Effect of Chipping Methods on Yield of Naval Stores". Submitted for publication in 1927 Department of Agriculture *Yearbook*. October, 1927.
Wahlenberg	"Chemical Weed Control at the Savenac Nursery, Western Montana". Submitted to *Forest Worker*. October, 1927.
Hadley (revised by Pessin and Wahlenberg)	"Effect of Burning and Cattle Grazing on the Survival of Longleaf Pine Seedlings". (A Progress Report.) Submitted for publication in *Journal of Agricultural Research*. September, 1927.
Wakeley	"Planting Southern Pines". Submitted for publication in 1927 Department of Agriculture *Yearbook*. September, 1927.

Wakeley	"Producing Pine Nursery Stock in the South". Submitted for publication in 1927 Department of Agriculture *Yearbook*. September, 1927.
Pessin	"Mycorhizas of Southern Pines". Submitted for publication in *Ecology*. June, 1927.
Barrett	"Thinnings in Second-Growth Southern Pines". Submitted for publication in 1927 Department of Agriculture *Yearbook*. October, 1927.

b. Proposed, Oct. 16, 1927 - Oct. 15, 1928

Barrett	"A Study of Accelerated Growth of Longleaf Pines Resulting from Conservative Lumbering at Urania, Louisiana". Proposed as an article for *Journal of Agricultural Research*. January 1.
	"Application and Accuracy of Swedish Form Point Method of Estimating Cubic Volumes of Stands of Second-Growth Southern Pine". Proposed for *Journal of Forestry*. June 15.
	"Fires in the Piney Woods" (based on pictures and general results of Roberts Plots). Proposed for *Nature Magazine* or *American Forests and Forest Life*. January 15.
Demmon	"The Effect of Fire Upon the Pine Forest of the South". Proposed as a departmental bulletin; about 32 pages, 16 illustrations. July 1.
	"The Extensive Survey Method of Sample Plot Work". Proposed for *Journal of Forestry*. April 1.
	"Forest Types in the South".
Wakeley & Hayes	"The Commercial Plantations of the Great Southern Lumber Company". Proposed as an article for the *Journal of Forestry*. January 1.
Hadley & Wakeley	"Kiln Extraction of Pine Seed". Proposed as an article for *Journal of Forestry* or *Lumber Trade Journal*. April 1.
Wakeley	"Results of Nursery and Planting Investigations in the South". Proposed for a departmental bulletin. October 1, 1928.
	"Seed Descriptions and Yields". Proposed as an article for the *Journal of Forestry*. June 1.

Wakeley	"Heat Damage to Shortleaf Pine Seedlings in the Cotyledon Stage". Proposed as an article for the Journal of Agricultural Research. June 1.
Wahlenberg	"Cattle, Fire and Longleaf Pine". Proposed as an article for American Forests and Forest Life. May 1.
Wyman	"Gum Yield Table - Results of 1927 Season". Proposed for Naval Stores Review. January 1.
	"Crown Surface in Relation to Gum Yield". Proposed for Journal of Forestry. February 1.
	"Relation of Gum Flow to Environment". Proposed for Ecology. April 1.
	"Dry-Facing in Slash Pine Timber". Proposed for Journal of Agricultural Research. May 1.
	"Results of Naval Stores Investigations at Starke, Florida, during the five-year period 1923-1927". Proposed as a departmental bulletin. September 1.

AGRICULTURAL REFERENCE DEPARTMENT
CLEMSON COLLEGE LIBRARY

ANNUAL REPORT AND PROGRAM

of the

SOUTHERN FOREST EXPERIMENT STATION

1928

STAFF

SOUTHERN FOREST EXPERIMENT STATION

Permanent Members

E. L. Demmon, Director
L. Wyman, Associate Silviculturist
L. J. Pessin, Associate Forest Ecologist (reinstated June 1, 1928)
W. G. Wahlenberg, Assistant Silviculturist
P. C. Wakeley, Assistant Silviculturist
L. I. Barrett, Junior Forester
E. W. Gemmer, Junior Forester (Assigned to Choctawhatchee National Forest)
V. L. Harper, Junior Forester
F. I. Righter, Junior Forester (appointed July 2, 1928)
L. D. Vining, Superintendent of Naval Stores Field Station (Starke)

Miss V. M. Spuhler, Senior Clerk
Mrs. H. C. Black, Assistant Clerk-Stenographer
Miss M. C. Regan, Assistant Clerk-Operative
Miss M. E. Turnbull, Assistant Clerk-Stenographer (In cooperatio with District Forest Inspector)
Miss May M. Patchett, Junior Clerk-Stenographer (appointed September 15, 1928, at Starke)
Mrs. E. O. Harper, Junior Clerk-Stenographer (resigned September 30, 1928, at Starke)

R. M. Lindgren, Office of Forest Pathology

Professor G. H. Lentz, Special Investigator on hardwoods (in cooperation with Division of Forestry , Louisiana Department of Conservation)

Temporary Field Assistants

Q. R. Boerner
C. H. Coulter
R. W. Hayes
F. G. Hills
S. J. Johnson
W. W. Koch
L. D. Lloyd
J. A. Putnam
W. R. Silcocks
G. E. Trafton

Annual Report and Program

# of the

Southern Forest Experiment Station

1928*

General

The Southern Forest Experiment Station, one of 11 regional forest experiment stations in the United States, was established in July, 1921. Its territory embraces that part of the coastal plain region extending from Georgia and Florida in the East to Texas and Oklahoma in the West, a total land area of over two hundred million acres. The function of the Experiment Station is to determine for this region, which is capable of producing approximately one-third of the timber requirements of the United States, the best methods of growing timber crops on forest land. Through field experiments carried on at various points throughout the region, and which will serve also as demonstration areas, the best methods of managing and protecting forests for the production of timber, naval stores, and other forest products, and the effects of forests on water flow and erosion will become known.

The appointment of a State Forester for Florida, in April, 1928, brought the number of states in this region which have regularly established state forestry organizations up to seven, leaving only Arkansas without any such organization. Efforts are now under way in that State towards obtaining a state forestry law. An Arkansas Forest Protective Association has recently been formed, and it is to be expected that Arkansas will soon fall into line with the other southern states.

Fire protection continues to be the most important function of the various state forestry organizations, and public sentiment grows more favorable each year towards securing better protection from fire, the most serious threat to forestry in the South. Additional land is being put under fire protection each year, private lumbering interests are coming to realize the benefits of eradication of the fire evil, and Federal and State allotments for fire protective purposes are increasing annually. The following table indicates the present status of the work.

State	1 Total Land Area	2 Potential Forest Land	3 Area Protected from Fire 1927	Amount Budgeted for Fire Protection, Fiscal Year 1929			
	In Thousands of Acres			In Thousand's of Dollars			
				Fed.	State	Private	Total
Ala.	32819	20640	10637	43.1	30.5	13.5	87.1
Ark.	33616	23073	5068	No cooperative fire protection			
Fla.	35111	25170	620	30.0	8.0	22.0	60.0
Ga.	37584	22180	1939	38.4	10.5	105.2	154.1
La	29062	17847	3566	39.9	42.3	38.6	120.8
Miss.	29672	18372	1000	33.4	16.0	22.5	71.9
Okla. 4	4324	3498	1360	15.6	6.8	12.0	34.4
Texas 4	17231	12379	8588	30.7	32.4	5.8	68.9
Total	219419	143159	32778	231.1	146.5	219.6	597.2

---

* This report covers the period from October 16, 1927, to Oct. 15, 1928.

1. U. S. Forest Service Statistical Bulletin 21, 1928.

2 Computed from Agricultural Census, 1925, by deducting crop land, unwooded pasture, and land in buildings, roads, etc., from total land area.

3. From State Forester's estimates. Unfortunately these figures give no indication of the degree of protection afforded, so that it is impossible to compare one state with another.

4 Areas included within boundaries of pine and hardwood bottomland only.

There is no better evidence of the growth of forestry in the South than in the number of men throughout this region who have had technical training in forestry or who are now engaged in some phase of forestry work. Ten years ago the foresters in the South could be counted on the fingers of one hand. Today in the eight states within the Station territory there are 138 men doing forestry work of some kind, 118 of whom have had technical training at a forest school. Further, there are 43 men with some technical training in forestry who are now engaged in other lines of endeavor

Foresters in the South.

State	Some Technical Training		No Technical Training	Total
	In Forestry or Allied Work	Not in Forestry	In Forestry	
Alabama	6	3	5	14
Arkansas	22	2	6	30
Florida	18	17	1	36
Georgia	18	2	1	21
Louisiana	31	3	2	36
Mississippi	10	1	3	14
Oklahoma	3	8	1	12
Texas	10	7	1	18
Total	118	43	20	181

These foresters are in following lines of employment:

Lumber companies	32
Forest products (treating plants, etc.)	16
Consulting foresters and staffs	19
State forestry organizations	29
State extension foresters	6
U.S.Forest Service (administrative and research)	29
City foresters	2
Forest School faculties	5
	138
Men with some forestry training, not now in forestry work	43
Total	181

Notwithstanding this number of men with forestry training in this region, there is almost always some forestry position open for the qualified man. There is ever increasing need for men trained in southern conditions. It is recognized that this need can best be met through graduates of the two southern universities where courses in forestry are offered, at Georgia State College of Agriculture (course established 1907) and at Louisiana State University (established 1925). The continued development of these two schools should go a long way towards placing forestry in the South on a higher level. Every encouragement should be given looking to the upbuilding of these two institutions.

ADMINISTRATION

Advisory Council

This committee, consisting of twenty-four business, professional, and scientific men representing forest and allied industries from all sections of the Station territory, was originally appointed by the Secretary of Agriculture in 1925. The members serve without compensation, and in annual meetings consider, discuss, and make recommendations on the program of the Station.

The terms of eight Council members expired this year, Messrs. Boyd, Bunker, and Hardtner being reappointed by Secretary of Agriculture, Wm. M. Jardine. To the places made vacant by Messrs. Barre, Goodyear, Lee, McIntosh, and Thompson Secretary Jardine has appointed F. H. Farwell, Vice-President and General Manager of the Lutcher and Moore Lumber Co., Orange, Texas; Prof. Gordon D. Marckworth, in charge of the forest school of Louisiana State University; Colonel W. H. Sullivan, General Manager, Great Southern Lumber Company, Bogalusa, Louisiana, and H. M. Wilson, Vice-President, Baldwin-Lewis-Pace Company, Jacksonville, Florida.

A highly successful Council meeting was held at New Orleans, October 29, 1927, at which 10 members and 4 representatives were present. At that time it was recommended that the following meeting be held in the field, at or near one of the Branch Stations. Accordingly, the 1928 meeting was held at Valparaiso, Florida, near the Choctawhatchee Branch Station, on November 2 and 3. This marks the second field meeting of the Council, the first having been held at Bogalusa in 1926. The Council has tentatively planned to alternate the meetings between New Orleans and various centers of work in the field. Such field meetings give the Council members an opportunity to see the Station's work on the ground and in this way to obtain a clearer view of the problems and methods of solution.

Organization

The territory covered by the Southern Station has proven so large that it has been impossible to cover it adequately with the personnel and appropriations provided. It was this fact that prompted an alteration in the regional boundary so that the State of South Carolina is now included with the district served by the Appalachian Forest Experiment Station. This seems entirely logical, especially as this State is easily accessible from the Appalachian Station headquarters in Asheville, and the problems there are very similar to those found in the adjacent state of North Carolina. There must always be some overlapping between the work of these two stations, and the naval stores problems for South Carolina will continue to be undertaken by the Southern Station. The experimental work already established in South Carolina by the Southern Station was transferred in April, 1928, when that district was visited by field parties from the two stations.

With the assignment of two forest pathologists to the Southern Station, and with the man furnished by the State of Louisiana for the hardwood investigations, together with an extra clerk most of the time, the headquarters office is becoming more crowded. Continued expansion in personnel will make it necessary to acquire more space than is now available in the Customhouse. Although it is possible to obtain ample space in the Army Supply Base, the relative inaccessibility of that building from the center of the city is a distinct disadvantage.

The Station was visited by Mr. E. N. Munns, Chief of Office of Experiment Stations, in the fall of 1927, for a period of about two weeks. F. H. Eyre of the Washington Office was detailed to our Station for a month early in 1928 and spent some time at each of the centers of work, familiarizing himself with the various projects under way.

During the summer of 1928 Demmon was given the opportunity of spending five weeks at the California and Southwestern Forest Experiment Stations. The contact with the research staff in those regions and the opportunity to see the results of sample plot work, some of which is the oldest in the Forest Service, gave him a new viewpoint on many forest research problems. He gained a great deal from being able to meet other forest investigators and discussing with them problems of mutual concern.

The Station's accounts were thoroughly inspected in March, 1928, by Mr. Zimmerli, of the Washington Office. It was possible for Miss Spuhler to visit the Starke and Choctawhatchee branch stations during the year, where she helped to straighten out the files and check over the office records.

The number of branch stations remains four, the same as last year. These include the naval stores branch at Starke, Florida, the Choctawhatchee center of work, the personnel for which is being furnished by the Eastern District organization of the Forest Service, the substation at Urania, Louisiana, and the Bogalusa-McNeill center. The possibility of establishing additional branch stations is kept in mind, but it is recommended that such centers be chosen only at such time as the Station resources justify an enlargement of the present staff and program. In the meantime, the Station staff is each year becoming better acquainted with the region so that when the time comes to select additional centers of work, a considerable fund of information will be available as to the choice of localities.

Allotment

The Station allotment for the fiscal year 1929 remains practically the same as last year, $41,200. The McSweeney-McNary forest research bill that was enacted into law at the last session of Congress provides authorizations which will gradually increase the appropriations for forest research.

The project distribution of the allotment of $41,200 for the fiscal year 1928 was as follows:

Project	Amount	Per cent
Protection, fire	$2,606.08	6
Measurements	1,025.32	3
Management	6,614.11	16
Naval Stores	17,835.83	43
Forestation	4,844.15	12
Protection, others	5,692.38	14
Hardwoods and other Investigations	1,018.13	2
Mississippi Flood Study	1,630.43	4
Totals	$41,266.43	100%

Personnel

After serving as Acting Director of the Station since July, 1927, Demmon was appointed Director August 1, 1928.

Dr. L. J. Pessin, who resigned his position as Associate Forest Ecologist with the Station in June, 1927, returned to the Station staff one year later, in the interim having been employed as Plant Pathologist at the Texas State Agricultural Experiment Station. Because of his intimate knowledge of plant physiology and allied sciences, and his experience and personal ability, Dr. Pessin's reappointment very greatly strengthens the staff of the Station.

On July 1, 1928, F. I. Righter, a graduate of the Cornell Forest School, was appointed to the Southern Station as Junior Forester. This leaves but one vacancy on the staff not yet filled, that of Associate Silviculturist.

Mrs. V. L. Harper resigned her position as Junior Clerk at Starke on September 30, 1928 and the vacancy was filled by the appointment of Miss May M. Patchett.

During the last year, 41 man-months of temporary technical assistance has been used, most of the ten men being forestry students who had not yet completed their college courses, but who desired to obtain field experience before returning to school.

Extra clerical help amounting to one clerk for 13 months has been necessary during the past year. The extra work involved by reason of the increase in men attached to the Station seems to justify the appointment of an additional junior clerk.

By reason of the Welch bill the salaries of all permanent members of the Station staff were increased in various degrees on July 1, 1928.

Cooperation

The Station continued to enjoy the closest cooperation of a number of landowners near the various branch Stations, especially the Urania Lumber Company and the Great Southern Lumber Company. Other Government units have also worked in close harmony with the Station in a great variety of ways. Among such agencies are the Coastal Plain Experiment Station at McNeill, Mississippi, the Bureau of Entomology, Plant Industry, and Chemistry and Soils at Washington, the Forest Products Laboratory, the Eastern District of the Forest Service, members of the Washington Office, including Dr. Cary, Mr Mattoon, Mr. Peters, Mr. Ashe, and others.

The Station is fortunate in sharing headquarters with Clarke-McNary Inspector C. F. Evans. This enables us to keep in closer contact with the various state foresters than would otherwise be possible, and offers an additional means of interchange of ideas between different units of the Forest Service.

The seven state foresters in the Station region have on numerous occasions cooperated with the Station in the furtherance of its program. Each of the State foresters in the Station territory has on numerous occasions given the Station the benefit of his knowledge of conditions in his particular state. State men have been assigned to our extensive survey crews and in many other ways the State Foresters have shown their keen interest in our work.

In the course of the extensive surveys in southern Georgia during the spring of 1928, Captain I. F. Eldredge of the Superior Pine Products Company, and A. K. Sessoms of Cogdell were especially helpful to the Station crew.

The Station has cooperated with the Society of American Foresters in making an Industrial Forestry inquiry to find out just what companies in the South are making a conscientious effort to grow timber crops commercially and the extent of their efforts thus far. In this connection, reports have been received from twenty-five lumber companies in the states of Mississippi, Louisiana, Texas, Arkansas, and Oklahoma, representing four million acres of forest land on which efforts of one kind or another are being made to grow a new crop of trees.

The cooperative project which was initiated last year between the Station and the Eastern District organization of the Forest Service, on the Choctawhatchee National Forest, has progressed very satisfactorily. During this period, Junior Forester Gemmer has been in charge of the project, and has had the assistance of a number of men from the Station staff at various times throughout the year, for a total of 17 weeks. The results of these experiments will serve as a basis for future management plans for the Choctawhatchee National Forest, and they should also be applicable to an adjacent belt of somewhat similar country where deep sandy soils prevail.

The Forest Products Laboratory in 1927 initiated a study of the relation of environmental conditions to the growth and properties of wood and the plots were located on the Choctawhatchee Forest. The Station has gladly assisted in a number of ways on this project.

Mr. O. M. Freeman of the Office of Economic Botany of the Bureau of Plant

Industry, spent a few days during June, 1928, on the Choctawhatchee Forest and with the assistance of Gemmer and Pessin of the Station staff and Lodewick of the Forest Products Laboratory, made a collection of native legumes. The purpose of this survey was to determine the desirability of native legumes as soil building plants. Because of their scant foliage, these native legumes are of little value in promoting soil fertility. It is planned to try out a variety of cover plants for this purpose, and seed of some of these has been promised by the Coastal Plain Experiment Station at McNeill, Mississippi.

In the naval stores region, the Station has been cooperating with Dr. Gerry of the Laboratory in her study of oleoresin production in the tree and factors influencing gum flow. Dr. Austin Cary of the Washington Office is also in close contact with our work at Starke, where he has now established his winter headquarters. We look forward to cooperating more closely with Dr. Cary in the future than has been possible in the past.

Through additional Congressional appropriations, totalling $10,000 annually, it has been possiblo for the Bureau of Plant Industry to assign two forest pathologists to the Southern Station, these men to work directly under the Bureau of Plant Industry but in close contact with the Station. One of these men, R. M. Lindgren, established his headquarters with us at New Orleans on August 1, 1928, and the other appointment is expected to be made shortly. Mr. Lindgren will confine his investigations to wood products, principally blue stain, while the other pathologist will concentrate on the forest tree diseases.

In the past the need has been suggested for forest entomologists and forest biologists to be assigned to the Southern Station. This very desirable form of cooperation is already under way at a number of forest experiment stations, and the results have been most satisfactory. The need for this work increases as time goes on, and it is again urged that forest entomologists and biologists be assigned to the South to assist in working out a more adequate forestry program for the region.

State Cooperation

During the last year, the State of Louisiana, through its Division of Forestry, has made it possible for the Station to begin investigations of Southern hardwoods. For this purpose the State set aside $5000 out of which were paid the salary and expenses of an investigator, Professor G. H. Lentz, on sabbatical leave from the New York State College of Forestry at Syracuse University. Professor Lentz began his assignment December 10, 1928, and since that time has been making an economic survey of the hardwood situation in Louisiana. He has had the assistance of a temporary technical man, Mr. Putnam, and has carried on his entire program of work under the direction of the Station. The State of Mississippi had expected to cooperate with the Station on a similar basis but was unable to finance the project during the last year.

The need for hardwood studies is urgent in all of the Southern States, especially those from which most of the nation's supply of hardwoods originates. The Station is unable to initiate such studies at the present time as all of its allotment is budgeted against projects already under way in the pine territory. The need for hardwood investigations is steadily increasing and until such time as Congress may provide additional funds, such studies can be begun only with outside assistance. The Station will gladly undertake the direction of any work which may be made possible by cooperating agencies.

Public Relations

The Station has been called upon frequently as in former years for a great variety of information on forest research and related subjects. Besides a considerable amount of correspondence, these requests have led to the preparation of a number of articles. especially during American Forest Week in April, 1928. Members of the staff have also addressed representative groups on technical and popular phases of the Experiment Station work. The branch stations and headquarters office have entertained a number of visitors during the past year, mostly scientists and people particularly interested in forestry work.

Among the meetings attended by members of the staff were the American Association for the Advancement of Science at Nashville (Harper, Wakeley, Demmon); Southern Forestry Congress at Louisville (Demmon); American Forestry Association, St. Louis (Demmon); Pine Institute Get-together at Savannah, (Wyman, Harper, Vining); Georgia State Forestry Fair at Waycross (Wyman, Vining, Harper); Southern Pine Association and Southern Logging Congress at New Orleans; Fourth International Congress of Entomology, at Ithaca, New York (Wakeley). During the year Wyman addressed ten meetings where turpentine men were gathered together, and reached an audience of 600 people by this means.

A naval stores exhibit prepared at Starke was shown at the State Forestry Fair at Waycross, Georgia. the State Agricultural Fair at Meridian, Mississippi, and the Fair at Savannah, Georgia.

INVESTIGATILNS

Oct. 16, 1927 - Oct. 15, 1928.

Flood Control Study

To supplement the material collected in July and August, 1927, the Washington Office requested the Station to revise for publication the former reports on the relation of forests to erosion and stream flow in the Lower Mississippi and Red River-Ouachita drainage basins. This revision was completed in August, 1928, but additional data on moisture holding capacity of forest litter have been obtained from 27 samples of litter collected near the Urania and Bogalusa branch stations during October, 1928.

The effect of fires on the water-absorbing capacity of the forest litter is strikingly shown by samples from our fire plots at McNeill, Mississippi. The leaf-litter on an annually burned plot in young longleaf second-growth was able to absorb only one-seventh as much rainfall as the litter on an adjacent plot which had not been burned for six years.

The Station's report will be incorporated in the general Mississippi drainage flood report now being prepared at Washington. This study has been requested by the President for the purpose of ascertaining the extent to and manner in which the floods of the Mississippi Valley may be controlled by proper forestry practice. Although the Mississippi flood problem cannot be solved by forests, their beneficial effect in equalizing the run-off of rain water and in preventing soil erosion should not be overlooked in any comprehensive plan of flood control. It is possible that forests as a crop on overflow lands and outside levees could be used to help defray part of flood control expenditures.

Thus far the relation of forest growth to erosion and flood control has been judged only from general observations and a review of what little literature could be found on the subject. The need for fire protection, the use of better agricultural practices, the regulation of grazing, the replanting of waste and eroded lands and the need for proper methods of forest management are all recognized, but accurate information as to the specific effect of each of these factors on floods has not yet been ascertained. For this, detailed and intensive research is essential. The Station recognizes the need for such specific information but can undertake such additional studies only if increased appropriations and personnel are made available.

Fire Studies

Fire continues to be the greatest menace to forestry practice in the South, as it does in practically every forest region in the United States. It is impracticable to put into effect the various recommendations given out by the Station to insure obtaining continuous crops of timber on forest land unless adequate protection from fire is afforded. The Station has not undertaken fundamental studies of fires such as those related to combustion of fuels and behavior of fires, as it is felt that such studies can be undertaken to better advantage by some central agency, equipped with adequate means for conducting them. The best methods of fire prevention, detection and suppression should be left to the administrative organization of the Forest Service, whose officers are in an advantageous position to try out various methods on the ground and under a great variety of conditions. Studies of the occurrence of fires have been undertaken at a number of experiment stations, but the value of such studies in the South is doubtful until such time as there is a closer correlation between the methods of reporting fires in the various states and until the completeness and reliability of the figures warrant their use for statistical analysis.

The Station studies relating to fire have therefore been directed towards determining the actual damage caused by fires and thus far these studies have been limited to the various pine types. At several points in the South, permanent plots have been laid out and seasonal burns made to bring out the effect of season of burning and the actual damage which occurs in each case. The plots selected for study were of fully stocked stands of the four southern pines, longleaf, shortleaf, loblolly, and slash. The results of the first five year remeasurements have been tabulated but no definite conclusions have yet been drawn. It has been found that some of these plots were not comparable in volume of stand to begin with so that the growth per cent figures do not bring out the actual effects of the fires. The accidental burning of one of the check plots in the slash pine series near Starke has necessitated the abandonment of this series.

A number of extensive fire studies have been made during the last four years in connection with the surveys of cut-over areas throughout the South. The analysis of all the field notes has not as yet been completed, although the results of the studies made in south Georgia in April, 1928, were summarized in a paper by Demmon entitled, "The Effect of 1927 Spring Fires in Southern Georgia." These particular studies showed conclusively the value of fire protection. On lands which had been protected from fire for a number of years, even severe summer fires did not entirely wipe out the slash pine that had come in as a result of the protection. The nucleus of a new stand of trees remained after the fire, whereas with annual fires, pine reproduction does not have an opportunity to establish itself. Analysis of the data also brought out the fact that turpentined trees are much more susceptible to fire damage than are round trees.

A similar study made in southeast Louisiana to determine the effects of a winter fire showed that between 77 and 85 per cent of loblolly pine seedlings were fire killed. Even here the nucleus of a new stand remained, but all one and two-year-old seedlings were wiped out. When fires recur every year or two there is no possibility of obtaining well stocked stands of second-growth pine.

In northern Louisiana it was found that 14-year-old longleaf pines are more than twice as tall on protected areas as on land burned annually.

The relation of fire to the establishment of longleaf pine seedlings and to the spread of oak brush is one of the most important of the problems being investigated at the Choctawhatchee branch.

The bulletin on "Forest Fires in the Coastal Plain" is still in the process of preparation. Demmon has been unable to spend the time on this that he expected but has made considerable headway in working up the extensive survey field notes which will serve as the basis for a considerable part of this proposed publication. It is planned to have this manuscript ready for submission to Washington early in 1929.

Measurements

Although Forbes's manuscript on "Volume, Yield, and Stand Tables for Second-Growth Southern Pines" has been submitted to Washington for publication, the printing funds of the Forest Service are at present so restricted that there seems little possibility of this publication being available for distribution before the end of 1929. In the meantime, additional copies of the preliminary tables and accompanying text which were given very limited distribution last year, will be mimeographed and made available to those requesting information on the growth of southern pines.

Early in 1928 a party from the Station tried out the application of these tables to second-growth longleaf pine stands on typical areas in southwest Louisiana. As a result of these field studies, it was possible to estimate the growth possibilities of longleaf pine in that region. It is proposed to try out the application of these tables in all parts of the South and to demonstrate to those companies interested in timber growing the value of the southern pine growth study in formulating their management plans.

The study of growth of trees left after cutting, based on individual measurements of 50 longleaf pine trees near Urania, Louisiana, has been incorporated in a manuscript prepared by Junior Forester Barrett. The manuscript is now being reviewed and as soon as it is in shape for publication it will be submitted to Washington and will probably appear in the Journal of Agricultural Research. The study brought out the fact that longleaf pine trees left after logging show a greatly accelerated growth as a result of release from competition. The increase in diameter is greater near the base of the tree, and more pronounced in small trees than in large ones. Within the allowed limits of error, volume tables for virgin longleaf pine stands can be applied to these trees left after logging, notwithstanding minor changes that take place in the form of the trees.

The establishment in different parts of the South of permanent yield plots for the study of second-growth stands of varying degrees of stocking are contemplated, to be made during future extensive surveys and where possible, in cooperation with state agencies. In this connection, the check plots on all thinning experiment areas will serve as yield plots for fully stocked stands.

Management

For the same reasons that the Pine Growth bulletin will not appear this year, the manuscript on "Timber Growing and Logging and Turpentine Practice in the Southern Pine Region" will probably not be published before the end of 1929. The delay in publication of this bulletin is greatly regretted as it represents the most important single contribution from the Southern Station thus far. It contains results of a great number of the studies carried on by the Station and presents a clear picture of the possibilities of forestry in the South and essential methods whereby forest lands in this region may be kept fully productive.

During the past four years, extensive surveys of cut-over areas in various parts of the South have been made by the Station staff, all of the members having at one time or another been assigned to these extensive studies. Not only have these surveys proved of great value in familiarizing the staff with this large territory, but they have yielded information related to management, fire, and naval stores projects, and have given the basis for selection of areas for more intensive studies in the future. One month during the spring of 1928 was spent on surveys in south Georgia and the coastal plain of South Carolina. It is planned to continue these surveys each year until representative districts in the entire southern region have been visited. Central and northern Georgia and northern Alabama and Mississippi have not yet been visited and other parts of the southern region have not been covered adequately.

Methods of cutting and reproduction studies are under way at a number of points throughout the southern territory. Annual cone counts on seed trees are made in connection with a number of projects. The method of cutting study in virgin longleaf pine established a number of years ago near Bogalusa, Louisiana, on what is known as the "200-acre" tract, has not proven wholly satisfactory, as the area is not typical of the longleaf pine type. Furthermore, the results will be applicable, for the most part, only to virgin timber stands. Since the bulk of the virgin timber will be gone before conclusions can be reached by means of such studies, it is recommended that any future studies of methods of cutting be established in young merchantable stands and in cooperation with lumber companies planning on continuous production of timber, both where trees are left for future cutting or as a source of seed. The establishment of plots of this kind should be distributed over a period of years so that future remeasurements may not all come at one time.

Additional plots to study the establishment of pine reproduction and its survival on areas with seed trees where cutting took place some years previously are also contemplated. Some of the plots already established for this purpose have not proven entirely satisfactory and it is planned to put in additional ones, using the method of reexamination developed on the McNeill grazing and fire plots.

A number of new thinning plots in loblolly and shortleaf pine have recently been established near the Urania branch station. These plots should prove of more value than the ones established in 1915 as a method has now been developed to overcome the inconsistencies that showed up in the analysis of the former work.

There is need for additional thinning plots in shortleaf pine and in second-growth longleaf and slash pine in the southeastern states. It is recommended that we take advantage of the cooperation offered by Dr. Cary in the establishment of a number of these plots in that region during the coming year.

A study of the factors influencing the establishment of natural reproduction on the Choctawhatchee Forest is one of the most important of the problems being undertaken at the Choctawhatchee Branch. Detailed meteorological observations are being made daily to correlate climatic factors with growth and survival of pine seedlings, both natural and planted, under a variety of conditions. Records are kept of air and soil temperatures, humidity, evaporation, solar intensity and wind velocity.

Studies of the effect of root competition are being made by trenching to eliminate interference of brush and trees with the development of pine seedlings. The structure and arrangement of the root systems of longleaf pines of different sizes and of competing vegetation are being studied by means of washing away the soil. Root systems can be accurately mapped by drawings and photographs taken at intervals as the work proceeds. The aggregate number and volume of the roots which compete with the pines for soil moisture is amazing. It is impossible to conceive the amount of root development in this poor sandy soil until it is opened up to view.

A preliminary experiment to determine the water requirements of longleaf pine seedlings was begun at the Choctawhatchee Branch by Dr. Pessin. By means of carefully controlling the amounts of water supplied to potted seedlings it will be possible to determine the maximum, optimum, and minimum water requirements for longleaf pine seedlings on the poor sandy soils found on the Choctawhatchee Forest. This experiment should throw some light on the causes of mortality of seedlings and the difficulty of securing longleaf pine reproduction there. This experiment should be duplicated for each of the southern pines under varying soil conditions. It may be possible to obtain the cooperation of the southern forest schools and Tulane University in the conduct of similar work.

In order to determine the effect of dense grass cover on natural seeding to longleaf pine on areas which have been protected from fire for some time, several sample plots were sown with known quantities of seed The initial effort failed because of rodents burrowing under the protective wire screens and eating the seeds. Although the screens were placed flush with the ground and kept out the birds, it is evident that the protective screens must be sunk into the ground in order to forestall the rodents. This study will be duplicated again this year, both at Urania and at McNeill. Meanwhile it has thrown an interesting light on the factor of rodent damage in natural reproduction.

Naval Stores

The fall of 1927 marked the closing out of practically all of the original test trees on which work was started in 1923 including 330 longleaf trees and 550 slash pine. Remeasurements for growth were taken on all of these trees.

In 1928 several new tests were started, a total of 4,170 trees being worked this year. Among the new tests are the ones at Kiln, Mississippi, Camp Pinchot, Florida, Dukes and Union, Florida.

Work has been started on a proposed bulletin to cover all of the original chipping tests and the sections dealing with height of streak and depth of streak have been completed. The preparation of a semi-technical bulletin to be published by the Florida State Department of Agriculture has been approved and an outline drawn up covering the material. Plans are under way to cooperate in the publication of a naval stores hand-book.

NS - 1. Methods of Chipping. The final results of the height of streak test in slash pine show that narrow chipping (1/4 inch depth) gave yields which averaged for five years 6 per cent greater than were obtained from 1/2 inch chipping and 7 per cent greater than the yield from 3/4 inch chipping. These advantages came entirely during the fourth and fifth year of working as the result of evaporation and wastage of gum from long faces, above the tins which could be raised for only three years. Similar tests with longleaf gave less clear cut results, openness of stand offsetting style of work to such an extent that 1/2 inch chipping resulted in the highest yield of gum and the 1/4 inch chipping showed up the poorest. In some tests started in 1926 the wide chipping is running ahead in gum yield due to the greater facial area exposed, and resulting in cutting a larger number of horizontal resin ducts. How important these horizontal ducts are in relation to the vertical ones is a point which is not yet determined.

In the depth of chipping tests best results were obtained in the original slash pine from 1/2 inch chipping. In the original longleaf for five years the 1/2 inch chipping also gave the highest yields followed by the 3/4 inch depth.

In brief, it seems that higher gum yields are derived from deep chipping in the earlier years of work but this advantage is offset during the later years. The advantage of shallow work lies not in the difference in yield of gum but rather in the better health of the trees which are being operated.

The width of face tests have been carried on for the last three years and the results show that gum yields increase with width of face but not in the same ratio.

One new method of chipping test started in 1928 consisted of a comparison of French and American faces of the same width on the same trees. The French face yields were 17½ per cent ahead of the American. Some so-called split faces were started in longleaf pine timber and it is estimated that these faces yielded 25 per cent more than would have been obtained from the same width of face put on in the ordinary way.

NS - 2 Gum Production The relation of gum production to size of trees is being tried out in several localities. Two tests in slash pine in the flatwoods; one test in slash pine in a pond; one test in slash pine on well drained fertile soil; a test of longleaf in an old field in the sand hills; a test in longleaf slow growing timber in the sand hills and one in longleaf in the flatwoods. A comparison of the effect of soil on gum production can also be obtained from these tests. Yields from back-boxed trees are also being studied. The indications are that the yield from back-boxed trees is somewhat less than from front faces unless one or two years' resting period is allowed between the working of the successive faces.

Four kinds of commercial fertilizer were applied to different groups of slash pine trees this year An incomplete analysis of the effect of these fertilizers on gum production indicates that a greater gum yield was obtained where ammonium sulphate was applied, whereas the muriate of potash, acid phosphate and phosphate screenings gave yields which were less than were obtained from the unfertilized check group. The potash group in particular fell off badly in gum production and it is possible that the potash had a toxic effect on the trees, the application being too heavy. This, however, may not be the correct explanation of the lower yield. The experiment will be continued through another year and may show up differently during the second year of work

NS - 3 Environment Studies. Seventy longleaf trees are included in a study of the effect of environment on gum yield. These trees will have been worked for a year by January, 1929, and the test will be discontinued then until we have had time to analyze the results.

In response to a request from Miss Gerry, a few trees were chipped, starting in May and in July in order to see whether resin ducts are formed that late in the year. A few trees have been chipped daily since the first of July and the yield is beginning to decrease from these trees.

The gum gage which was used last year in a correlation of gum yield with temperature was put in use again during 1928 and will also be used next year. This is bringing out interesting relationships, showing the increased yield obtained during the day and the slowing down of the gum flow at night. It is not yet clear whether this is a result of the effect of temperature or the effect of light on photosynthesis and other tree activities.

NS - 4 Extensive Surveys. A party of three or four men were on naval stores extensive surveys for a month during the spring of 1928 in north Florida, Georgia, and South Carolina. Information on style of work done in commercial practice was obtained. The effect on growth of chipping was studied through stem analyses of trees blown down in storms. An opportunity now exists to analyze growth on the blowdowns resulting from the September hurricane and should be followed up this winter if possible.

New Plans

Practically all of the trees and tests in the methods of chipping studies will be continued through 1929 and 1930. As a result of the preliminary test with split faces and French faces carried on during the last season, it is suggested that a larger test be established, combining the good features of both. The disadvantage of the French face in the past has been the time required to make a streak. Tools have now been devised by Harper and Wyman with which it is hoped a considerable saving of time will be effected.

Plans for French face chipping call for placing one 3½ inch to 4 inch face on round 5, 6, and 7 inch trees, two such faces on trees from 8 to 10½ inches in diameter, three on trees from 10½ to 13 inches in size and four on 13 to 16 inch trees. It is possible to arrange the faces so that gum from three faces may run into a single cup. There are prospects of obtaining from 30 to 40 per cent more gum from the same amount of face through the use of French tools.

All work in the gum production test will be continued with the exception of one group of slash pine trees which have now been worked four years and which will be back-boxed in 1929.

In the environment study practically all of the field work will be discontinued during the year of 1929, pending the working up of results. Before recommending further work, a number of points should be tried out on a small scale by members of the staff. It is recommended that gum from certain of the Station's tests be analyzed for percentage of spirits and rosin. It may be possible to cooperate with the Bureau of Chemistry and Soils in this work. It will then be possible for the Station to express its findings in accurate terms without the necessity of using unreliable converting factors for transposing gum and scrape yields into turpentine and rosin. This has been a serious weakness in the method of expression of results in the past.

Forestation

Work in forestation during the past year, aside from the studies initiated at Camp Pinchot, has been limited mostly to necessary routine measurements and records, to computations of figures already gathered, and to preparation of reports. The two largest routine tasks were completion of seed records, especially for storage lots, and individual remeasurement of a trifle more than 23,000 planted trees. Wakeley prepared an article on "Southern Pine Nursery Practice" and another on "Planting Southern Pines", each to be published by the Department as an illustrated 8-page leaflet. These will probably be available for distribution early in 1929. Wakeley also assisted Professor Hayes, of the Louisiana State University Forest School, in the preparation of a 32-page technical bulletin on the establishment and early growth of commercially planted southern pines at Bogalusa. The manuscript of this bulletin is practically completed and will be put out as a publication of the University.

New work with seed included storage of longleaf seed, of the 1927 crop, sterilized with formaldehyde and sealed in sterilized glass jars. This was suggested by the successful storage by this method, for one year, of longleaf of the 1925 crop.

Supplementary lots were stored in unsterilized jars at room temperature, in unsterilized jars in cold storage, in jars under sterilization with DuPont Semesan, and in sphagnum moss moistened with salicylic acid. These new lots of seed have not yet been tested, since they must be held till the proper time for sowing fresh seed in the nursery.

Supplementary to these tests, samples of longleaf seed taken from an ordinary metal storage can, in an attic quite comparable to the toolhouses in which some lumber companies have stored seed, were tested every month, beginning in January, 1928. Each test was run 30 days. The germinability decreased sharply during May, dropping then from about 70 to about 20 per cent, while at the same time the period necessary for germination increased.

At Bogalusa the nursery work was confined to a series of surface soil temperature readings under half shade and in unshaded beds (130° F. being common in the latter), and to a large-scale test, in longleaf pine beds, of zinc sulphate as a means of controlling weeds. The precise results of the zinc sulphate test must await the lifting of the stock this winter. For all practical purposes, however, it is already evident from this and previous work at Bogalusa that the method, while effective against broad-leaved weeds, is of little or no use after grass has begun to invade the nursery. The pines succumb to a lighter dose of the salt than is needed to kill the grass.

The only new plantation made was one of 200 Monterey pines, 1-0 stock, most of which were insufficiently hardened when planted and accordingly suffered severely from frost damage. A small experiment in seed spotting with seed dusted with red lead was tried, in an attempt to control bird damage, but without success. Remeasurements of commercial plantations of the Great Southern Lumber Company, originally measured in 1926, showed that slash pine on slopes and ridges had in some cases overcome the lead in height growth originally shown by that on the flats, but still showed poorer survival.

Examination of our oldest experimental plantation, a loblolly spacing study, after five years in the field (six years from seed) showed encouraging recovery from tip moth damage, and good height growth. Many of the trees exceeded 8 feet in height. Trees of unusually good form and showing an apparent resistance to tip-moth infestation were marked for future seed trees with the expectation of developing a tip-moth resistant strain.

Longleaf continued to show the highest survival of any species in the experimental plantations, and to make height growth in excess of that of wild seedlings on the same area.

No new work will be started in forestation at the Bogalusa branch this coming year. Routine germination tests will be made of stored seed, and the annual examination made of plantations. The principal job will be to clear up the mass of accumulated data from experiments already performed.

Past work indicates three lines of study in forestation which the Station might undertake at some future date.

The first of these three studies would be of methods of storing pine seed, especially longleaf. Some work on this subject already has been done by the Station, but without very conclusive results. It is not yet possible, commercially, to keep the surplus of a bumper crop, like that of 1924, to tide over the lean years which sometimes follow, as they did in 1925 and 1926.

A study of the value of various fertilizers in forest nurseries might be desirable. Indications of apparent soil deterioration are already in evidence in some of our older southern pine nurseries, and it seems likely that before long we will have need for definite knowledge of the remedies to apply.

The third point is the establishment of mixed plantations of two or more species. Our own experience with rabbits, tip moth, drought, silting, fire, and variations in site already confirm the generally accepted fact that it is dangerous to establish large, even-aged plantations of a single species.

At the Choctawhatchee branch, 1000 one-year-old longleaf pine seedlings from the Bogalusa nursery were planted under varying conditions to determine the effect of root competition and shade of oak brush. A few slash and Monterey pines and cypress were planted at the same time. Weather conditions following planting were extremely favorable and practically half of the longleaf and slash have survived thus far. The cypress is doing exceedingly well, but the Monterey has mostly failed to come through.

Similar trials have been made with seed spots. Although ants were not quite so destructive as last year, birds managed to clean out most of the seed.

Nursery stock is being raised from native longleaf seed from known seed trees. Other nursery stock consists of small quantities of longleaf pine from Bogalusa and such exotics as western yellow, Bishop, Monterey, lodgepole, Jeffrey, and Coulter pines.

During the next year the Choctawhatchee nursery will be expanded to a capacity of 25,000, mostly longleaf pine, for use by the Choctawhatchee National Forest in their planting program. This will allow a more diversified program on a larger scale, the results of which can be recorded by the Station.

Grazing

The Station is cooperating with the Coastal Plain Experiment Sta. at McNeill, Mississippi, in what is probably the most comprehensive study ever undertaken of the effect of cattle grazing and annual burning on the establishment and survival of longleaf pine reproduction. A progress report of this experiment has been forwarded to Washington for publication in the Journal of Agricultural Research and should appear within a short time.

Records are being kept of seedlings of the 1924 and 1927 seed crops. The experiment was begun in 1923 and half the 320 acre plot has been burned annually since that time, approximating conditions that have prevailed for a good many years on most of the longleaf pine country in the South. Although the virgin timber was cut off over 20 years ago, sufficient seed trees are present (10 per acre) to assure restocking. From a count of seed caught in seed traps in 1927, which was a good seed year, it was estimated that between 70,000 and 80,000 seeds per acre were produced.

During the first five years, cattle were grazed on both burned and unburned plots (except for 10 acres of each), at the rate of one head to 10 acres. Both plots proved to be undergrazed; this past year, therefore, the cattle have been increased to one head to five acres on both pastures. This experiment should indicate that rate of grazing whereby the grass remaining at the end of the grazing season will not afford sufficient inflammable material for a serious fire.

Preliminary results obtained from this experiment are as follows:

Annual Treatment	Area in acres	Survival per cent of Longleaf pine	
		1924 seed crop in 1926	1927 seed crop in 1928
Burned and grazed	150	56	10
Unburned and grazed	150	75	75
Burned and ungrazed	10	18	8
Unburned and ungrazed	10	85	61

It has been found that close and even moderate grazing, by reducing the amount of fuel, greatly reduces the damage from annual fires. Where fires are prevented, the intensity of grazing does not seem to greatly affect survival, except on carpet grass areas. Where fires can not be eliminated, grazing should be found beneficial to reforestation.

Grazing appears to be profitable even on the inferior sedge and wire grass of the pine woods. Perhaps the greatest service of grazing to forestry in the South will come through the income it can supply to meet carrying charges on forest investments between periods of cutting. The indications are, however, that the two industries will ultimately reach their highest development independently. This is partially due to the fact that the best pasture grasses, such as carpet grass, do not seem to thrive under the shade of trees.

When cattle are widely scattered over a large range, annual burning of parts of the range may be advisable from the grazing standpoint. The grass which springs up on burned areas is more easily grazed and of greater palatability than that on unburned areas, which is mixed with the dead grass entirely devoid of nutrients. It is to the best interests of grazing that accumulation of grass be kept at a minimum. It would be to the best interests of forestry if pastures are grazed to sufficient capacity to make fires unnecessary.

An attempt was made to determine the effect of these annual fires on the soil density and moisture content. Thirty-two soil samples, equally distributed between burned and protected areas were collected in this study. The analysis of the samples indicated that the soil on the protected area was moister, less dense and more porous than on the burned area. Although the differences were not so great, they suggest a larger humus content in the soil protected from fire. These preliminary tests will be repeated and determinations made of humus and nitrogen content of the soils under the two conditions of treatment.

Insects

A little work has been done during the past year on cone insects and nursery pests. The principal entomological work, however, has been on the pine tip moth, which has seemed extremely serious on loblolly plantations. A series of cages placed on infested trees during the year has demonstrated the existence of four separate broods. A study of the damage leads to the belief that loblolly can still be planted successfully under certain conditions. A report on this work was read by Wakeley at the Fourth International Entomological Congress at Ithaca, N. Y., in August, 1928. Supplementary observations will be made in the future as opportunity offers.

The attention of the Station is frequently called to insect injury to various kinds of forest trees in different localities throughout the South. Serious insect infestations have been known to follow droughts and heavy turpentining. No work on insects has been attempted at the Station except as a side line to the regular projects. The need for a specialist to study these problems is becoming more apparent as time goes on and it is recommended that a Forest Entomologist be assigned to the Station at an early date.

Diseases

The principal pathological work of the Station during the year has been with brown spot of longleaf (caused by *Cryptosporium acicolum*), incorrectly called a "rust", which is of widespread occurrence and considered in some quarters a serious menace to plantations and young natural reproduction. In addition to the annual records on our planted longleaf seedlings at Bogalusa, we determined, by frequent microscopic observations, some new points in the life history of the fungus. Nine plots were laid out on an 300 acre burn near Bogalusa, to test the theory that woods burning controls the disease, but the whole area was reinvaded by the fungus before the summer was over. Meanwhile two dozen plots in dense longleaf reproduction, laid out in co-operation with the Bureau of Plant Industry and the Great Southern Lumber Company, were kept free of the disease by spraying, mostly with Bordeaux mixture; this not only indicates that the disease can be kept out of nursery beds, but will show what effect the presence or absence of the brown spot has on the growth of the trees in the field. This pathological work will be turned over to the forest pathologist as soon as he is assigned to the Station.

Other problems which await the forest pathologist are the effects of cone rusts and other diseases on seed production, the damping off of forest tree seedlings and the heart and butt-rots following fire injury in hardwood stands.

Forest Products Pathology

A start on products pathology work has been made by the appointment of R. M. Lindgren, who began work in the South August 1, 1928. Mr. Lindgren is working under the Bureau of Plant Industry but assigned to the Southern Station, where he maintains his headquarters.

Of the problems pertaining to the diseases of forest products in the South, the sap-staining and molding of domestic and export lumber has demanded first attention. A survey of existing conditions and practices has been in progress since August 1, 1928. The purposes of this survey are to determine (1) the extent of stain occurrence in different timber species and products, on a regional and seasonal basis, (2) the relation of various handling practises to the development of stain, (3) the current methods of control and the results, and (4) the economic importance in different products and under different conditions.

Forty-seven pine and hardwood mills in Louisiana, western Mississippi and eastern Texas have been visited during August and September. Of the southern woods, sap gum and the yellow pines were found to be the most susceptible to the stain and mold organisms. Very definite methods of control are being employed at every one of the different mills visited. Steaming and end-racking are the favored practises in the handling of sap gum. Stain is not considered a cause for degrade in sap gum, but mill operators are able to obtain premiums on any stock that is guaranteed to be bright. Kiln-drying of the higher grade lumber and soda-dipping of the yard stock are the common preventative measures in use at the pine mills.

The survey will continue until all phases of the problem have been covered, more or less intensively. Later, dipping and seasoning experiments on control will be established at various mills. The procedure to be used is such experiments will be governed by the information that the survey makes available.

Other problems in products diseases that will require consideration in the near future are the rots of buildings and structural timbers, the deterioration of logs in storage, and the relative durability of the southern woods. Fundamental investigations on these problems in the field and in the laboratory will have to be coupled with studies on the practical application of methods of control.

Hardwood Studies

The initiation of hardwood studies during the last year was made possible by a cooperative agreement between the Division of Forestry of the Louisiana Department of Conservation and the Southern Station.

It seemed advisable to first make a preliminary survey of the hardwood region, particularly the main bottomlands in Louisiana. The method of work followed very closely that used by the Station in the extensive surveys of cut-over pine lands. Sample strips were taken in representative hardwood stands to determine composition, severity of cuttings, amount of reproduction, damage from fire and flood, and in general, to work out a hardwood type classification.

A careful perusal of existing literature indicated that very little has been written pertaining to the bottomland hardwoods. With the exception of a few local tables, no volume or yield tables applicable to Louisiana hardwoods have been made, and little work has been done on the types, the rate of growth and yields under varying conditions.

During the first 10 months of the hardwood study, 60 hardwood mills were visited. Twelve of the mills had no timber of their own but were dependent on logs and stumpage that they could buy. Only 7, according to their own statements, had more than a 10 years' cut of virgin timber, while the average amount of virgin timber for all the mills owning stumpage was sufficient for about a 5 years' run. Many of the mills are cutting second-growth timber at the present time, while some will have to close down within the next five years for lack of timber of any kind. Only three hardwood operators were found to be practicing forestry and the aggregate area of their holdings is only 31,000 acres. They have merely made a beginning, whereas the others are cutting with no particular regard to the future. Until hardwood timber land operators can see the advantages of more conservative cutting and a practice of forestry, the present methods will continue.

Much of the hardwood cut within the next 10 years, and most of it after that time, will come from second-growth stands. These stands will be younger, of smaller sized timber and yielding less than the virgin stands that are being cut today. The logging costs may be higher and the quality of timber will be poorer than that cut from virgin stands.

Data concerning individual timberland holdings were obtained from the assessors of 23 parishes in the main hardwood region of the State. Where possible, these figures were then checked up with those obtained from the individual companies.

Most foresters in the past have assumed that fire losses are a negligible factor in the bottomland hardwood type, due to the moist or wet nature of the site. The extensive surveys have shown that the loss in the hardwood stands, due to fire, is as great, if not greater, than similar losses in the pine region. All of the hardwood stands north of the Red River and east of the Ouachita River showed some signs of fire injury, and the same was true of probably 75 per cent of the hardwood stands south of the Red River. It was found that serious fires had occurred very generally in 1916, and again in 1924, and the extent of injury varied from five per cent of the trees showing fire scars to complete wiping out of entire stands.

It was found that the flood waters of 1927 had killed a considerable amount of young growth. Where the water was deep enough to cover the tops of the trees and remained for several weeks at that height, the overtopped trees had succumbed. It is estimated that 80 per cent of the bottomland area in Louisiana was flooded in 1927 and the resulting loss of young growth must have been large. This fact should be taken into consideration if timber growing in the proposed spill basins is undertaken.

Without making a more detailed survey covering a greater per cent of the hardwood area than has been done thus far, it is impossible to estimate the amount of virgin hardwood timber remaining, or to give an accurate figure of the total area of cutover land. In Louisiana, the virgin cypress is practically gone, and only two large tracts of uncut cypress remain Of the mills now cutting cypress only one has as much as a 5-year-cut ahead.

This study has brought to light how little is really known about our southern hardwoods. As a result of the past year's work, the following list of investigations are proposed for future studies:

1. A logging and mill scale study to determine what size logs can be handled profitably.
2 Establishment of permanent sample plots in representative stands to determine what species come in after logging.
3. Preparation of volume tables for the more valuable and common species. particularly red gum, black oak, and ash.
4. Establishment of thinning experiments in second-growth stands of cottonwood and red gum.
5. Growth studies and yield tables for the various species on different sites.

It is important to know what yields can be expected from young stands and what cutting methods will assure a sustained yield. With a constantly decreasing supply of virgin timber, stumpage prices can be expected to advance materially. Although we may be convinced that fire prevention, selective logging, and reforestation of hardwood lands will pay, it is essential to have the substantiating facts. From the start already made, it is apparent that a vast amount of research and investigative work on hardwoods is needed.

In the case of some of the western stations it has been possible to set aside for experimental and demonstration purposes certain stands of virgin timber representative of original tree growth. Here in the South such areas are becoming rare, and the remaining virgin stands have often been culled and as a rule have suffered severely from fire. It is questionable whether the Government will be able to or should be expected to acquire by purchase areas of virgin timber for experimental purposes. It is probable that forest growth in the future will little resemble the virgin forests which are now fast disappearing, and it seems advisable to concentrate research activities on second-growth stands. It is to be regretted, however, that no measures have been taken to preserve and protect a number of wilderness areas in the South, to give to future generations a picture of the country as it was in pioneer days, and of the forest growth, the harvesting of which has contributed so largely to the economic development of this region. There remains the possibility of the States or public-minded individuals contributing towards the preservation of such areas which might be protected and administered as State forest parks.

Proposed Work

No material expansion of the Station's program is proposed for the coming year. In general it is planned to continue with the analysis of old field data and the completion of the manuscripts based on the Station's work to date. Current remeasurements and reexaminations of sample plots. and the regular naval stores program will be continued according to present schedules.

The manuscripts which are due to be completed during the coming year are: "Forest Fires in the Southern Coastal Plain," by Demmon; a progress report on the first five years naval stores investigations at Starke by Wyman; a summary of the results of the forestation work at Bogalusa. by Wakeley; and the results of the first year's investigations of hardwoods in Louisiana by Lentz. A number of articles bearing on the progress of the work will be prepared for submission to trade journals during the course of the year.

The establishment of a number of new thinning and yield plots and the checking of the second-growth southern pine tables might well go hand in hand. A number of thinning plots are being established in loblolly and shortleaf pine in northern Louisiana and southern Arkansas this fall. Similar plots should be established in longleaf and slash pine areas in the southeastern States.

At least one or two method of cutting plots in advanced second-growth stands should be established each year during the next few years. These plots should be put in in cooperation with timber landowners who plan to practice forestry and who are able to provide adequate protection from fire.

The extensive surveys of cut-over lands offer excellent opportunities for the newer staff members to become acquainted with the region and at the same time obtain information of value in working out forest management problems for the southern States. It is recommended that at least a month each year be put in on such surveys until the region has been adequately covered.

The program at the Choctawhatchee Branch should continue as at present and every effort be made to assist the administrative organization in working out plans for the future management of the Forest. In this connection such fundamental studies as that under way on the water requirements of longleaf pine seem to be an essential part of the program.

A number of the plots established by the Station in past years do not seem to be entirely satisfactory. The retention of these plots in the Station program should depend on the possibilities which they offer in the general advancement of forest research in this region.

The hardwood study should be continued as at present. The Station will furnish temporary technical assistance and take a share in the direction of the work but will not consider hardwood problems in the regular program of work until such time as additional finances are made available for this purpose.

There is keen realization of the urgency of investigations of the relation of forests to erosion and flood control, but no time will be available for studies of this kind, with the present staff. There is also increasing need for economic data on forest conditions in the South, such as: the extent of forest area by States and types, the area in virgin and second-growth timber, the rate of depletion, condition of the stands, etc.

The preparation of a forest type map and the general agreement on what forest types should be recognized for the Southern Station territory must not be overlooked in planning for future programs of work for the Station.

Studies of forest insects and wild life as they relate to the management of forest lands are in need of being undertaken, but must await the assignment of entomologists and biologists to the Station.

AGRICULTURAL REFERENCE DEPARTMENT
CLEMSON COLLEGE LIBRARY

ANNUAL REPORT AND PROGRAM

of the

SOUTHERN FOREST EXPERIMENT STATION

1929

STAFF OF

SOUTHERN FOREST EXPERIMENT STATION

October 15, 1929

E. L. Demmon	Director
E. A. Ziegler	Senior Forest Economist
Lenthall Wyman	Associate Silviculturist
L. J. Pessin	Associate Forest Ecologist
J. D. Sinclair	Assistant Forest Ecologist
N. T. Mirov	Assistant Silviculturist
W. G. Wahlenberg (Resigned March 5, 1929	Assistant Silviculturist
P. C. Wakeley	Assistant Silviculturist
L. I. Barrett (Transferred to Central States Forest Exp. Sta. Dec.15,1928)	Junior Forester
R. A. Chapman	Junior Forester
E. W. Gemmer (Assigned to Choctawhatchee National Forest)	Junior Forester
V. L. Harper	Junior Forester
H. G. Meginnis	Junior Forester
F. I. Righter (Resigned Sept. 24, 1929)	Junior Forester
P. O. Rudolf	Junior Forester
A. R. Spillers	Junior Forester
L. D. Vining (Resigned Sept. 9, 1929)	Superintendent of Naval Stores Field Station
J. A. Lubbe	Junior Administrative Assistant
Vera M. Spuhler	Senior clerk
Effie C. Herndon	Clerk-Stenographer
Mrs. H. C. Black (Resigned June 6, 1929)	Assistant Clerk-Stenographer
Camelia M. Larsen	Assistant Clerk-Stenographer
Agnes G. Terburg (In cooperation with District Forest Inspector)	Assistant Clerk-Stenographer
Marie E. Turnbull (Resigned Sept. 11, 1929)	Assistant Clerk-Stenographer
Elizabeth Bergland	Junior Clerk-Stenographer
May M. Patchett	Junior Clerk-Stenographer
Mary C. Regan	Assistant Clerk-Operative

Assigned to Staff by Other Agencies

P. V. Siggers (Bureau of Plant Industry)	Associate Pathologist
R. M. Lindgren (Bureau of Plant Industry)	Assistant Pathologist
Prof. G. H. Lentz (Louisiana Division of Forestry) (Resigned Dec. 15, 1928)	Special Investigator in Hardwoods

Temporary Field Assistants During 1929

Q. R. Boerner
Ralph W. Hayes
Richard H. May
W. R. Silcocks
J. W. Zehnder
Dale Chapman (Pathology)
Clyde Christensen (Pathology)

Vacancies on October 15, 1929 - 2 Silviculturists, 1 Assistant Forest Economist, and 1 Assistant Forest Ranger. and 1 Statistical Clerk

SOUTHERN FOREST EXPERIMENT STATION

- - -

Statement of Distribution to Projects

Fiscal Year 1929

Protection - fire	$ 2,273.93
Measurements	1,328.41
Management	12,172.77
Naval Stores	16,319.51
Protection - others	5,764.00
Forestation	5,717.63
Flood and Erosion Control	1,485.53
Total	$45,061.78
Total Allotment	$45,075.00

Allotment Fiscal Year 1930

Silvicultural Investigations	$49,700.00
Economics	22,800.00
Erosion Studies	10,000.00
Total	$82,500.00

R
Investigative Program

October 31, 1929

NINTH ANNUAL REPORT

of the

SOUTHERN FOREST EXPERIMENT STATION

October 16, 1928 to October 15, 1929

The forest problem of as large a country as the United States, with its immense extent of territory and the extreme range of conditions affecting forest growth, can be fully comprehended only after detailed consideration of the forestry possibilities of its component regions. In order to provide for an adequate future supply of timber and other forest products for the people of the United States, it will be necessary to determine the sum total of the forest production capacity of the several major forest regions.

Second to none in its bearing on the national timber supply problem is the South, that region composed of the Atlantic Coastal Plain and Gulf Coast states. With its immense area of forest land comprising over one-third of the total for the United States, with conditions extremely favorable for forest growth as well as for harvesting forest crops, and with its proximity to the greatest lumber market in the world, the South occupies a commanding position in providing for the present and future forest needs of the nation. Many millions of acres of forest land in the South cannot possibly be needed for agricultural purposes for many decades to come. If these millions of acres are to be utilized to the best advantage and not become an economic burden, steps should be taken to secure the measure of productiveness which forest crops alone promise.

Forestry involves an exceedingly complex combination of factors which should be considered before the formation of a forestry policy. The South has been fortunate in its wealth of virgin forests, the harvesting of which has played no small part in its economic development. The possibilities of growing continuous supplies of timber has been obscured by the vast area of original forest, most of which has by now been cut. Within a very few years, as the virgin timber supplies are exhausted, the Nation will be confronted with the necessity of growing new crops of timber or of developing suitable substitutes on a large scale.

The province of foresters is to ascertain and point out ways and means whereby continuous crops of forest products may be produced. The present methods of handling forest lands in the South will insure at least partial timber crops in the future, but, although a few forward-looking companies have made a very good start in planning for future forest crops from their holdings, it must be admitted that the timber growing industry in this region is still in its infancy. The various states are helping very materially in furthering the practice of forestry, particularly where state forestry organizations exist.

The demand for information as to the best ways and means of growing new crops of timber becomes more insistent each year. In anticipation of this need, National forest experiment stations have been established in each of the major timber growing regions of the United States. The principal purpose of these forest experiment stations is to determine the basic factors which influence the growth and use of forests. Before a sound forestry policy can be formulated for a region like the South, a great number of problems must be solved.

The research program of the U. S. Forest Service, correlated with those of other Federal, State, and private agencies, is attempting to analyze the problems of growth, protection, and the use of the forest land resources, looking toward a sound timber conservation policy, the development of which is essential to the economic well-being of the country as a whole. In order to determine that treatment of lands which will insure their highest use, it is necessary to understand the place which forestry in its branches occupies in relation to the economic and social structure of the region.

The eight southern states from Georgia and Florida in the east to the timbered portions of Texas and Oklahoma in the west are included in the territory of the Southern Forest Experiment Station. This Station is one of eleven in the United States, and was established in July, 1921. The research program at the Southern Station has gradually expanded from an initial annual appropriation of $15,000, which provided a technical staff of four men, in 1921, until in the fiscal year 1930 the appropriation amounts to $82,500 and the staff numbers 18 technical men, aside from the necessary clerical force.

The territory served by the Southern Station covers a total land area of approximately 200 million acres, of which 185 million acres were originally covered with a magnificant forest. Although there are no reliable statistics available as to the exact acreage and amount remaining, this original forest resource is being reduced at a rapid rate and cannot be expected to play an important part in the production of forest products for very many more years. It is estimated that there are 145 million acres of potential forest land in timber growth or best suited to the growing of timber in the Station's territory at the present time, with 45 million acres additional in Virginia and the Carolinas. When properly managed for the production of timber, this total area (190 million acres) is deemed sufficient to provide at least one-third of the entire timber requirements of the United States. Not only is the South producing a very large proportion of the soft wood requirements of the Nation (40% in 1927), but during the last five years an even higher proportion of all the hardwood lumber cut came from the South (50% in 1927). There can be no doubt that timber-growing will continue to represent a considerable proportion of the business of this region for many years to come, particularly as the acreage in agricultural crops in this section has been steadily declining during the last several years.

The amount of publicly owned lands represents but a fraction of the total forest land area in the South. The problem of timber-growing therefore for the most part devolves upon private enterprise and will be participated in only to the extent that satisfactory returns commensurate with the risk are promised.

The Southern Forest Experiment Station in its research program is undertaking to ascertain the forestry methods best suited to the conditions found in this region. The field work is carried on at a number of branch stations located in various points in the territory typical of some of the major forest types. Because of the relatively greater area of pine forest land in the South as compared with the extent of other forest types, and in view of the limited funds available to cover all the forest problems in the region, the Station program has been limited to the principal pine types. The field work consists in following through carefully planned small scale tests, the results of which will be applicable to the principal forest regions as a whole.

It is essential that the business of timber growing rest on a sound financial basis if it is to contribute its due proportion of current revenue. No timberland owner can be expected to engage in a business which does not give promise of profitable returns The first commercial forestry developments can be anticipated in those sections where conditions are most favorable for timber growth; however, regardless of the intentions of timberland owners a great proportion of the cut-over forest lands in the South will reforest themselves naturally. That nature is wasteful in her process of reforestation is evidenced by the slow growth of the old virgin stands and by the partial, and in many places almost negligible, stands that have come in since the cutting of the original forests took place. It is the province of the forester to improve upon nature's methods and to point out the methods whereby full and profitable use of forest lands may be obtained. As a basis for his recommendations the forester must be fully informed as to those forestry methods which will provide a high sustained yield of the most desirable and the best grades of forest products commensurate with the conditions. In anticipation of the time when the possibilities of continuous forest production are accepted, as well as to hasten that time, foresters have made a beginning in laying a foundation of basic data bearing on timber growing. It is anticipated that within a very few years the continuous production of forest products from the same land will be as generally accepted as is the annual production of farm crops now.

Problems of forest production present many angles, and the investigation of a number of these problems is being conducted by the staff of the Southern Forest Experiment Station. The Station's program has been prepared with the idea of attacking the most vital problems first, although it has not been possible to begin work on all the problems which influence the successful practice of forestry in this region. In this annual report of the Station a brief description of the present investigative program will be set forth.

The longleaf pine belt is a region covering about 90 million acres of land, of which 70 million acres are available at the present time for the production of timber and other forest crops. The reforestation of this immense area of land presents a problem of the greatest importance to the region and the Nation. It has been estimated that there are now about 10 million acres of this longleaf country so barren and denuded of forest growth that new stands can be obtained only by methods of artificial reforestation. Furthermore there are about 20 additional millions of acres which are producing at only a small fraction of their capacity. It is very difficult to find any longleaf land that is producing full forest crops; certainly not over one per cent can be put in that classification.

Part of the longleaf land is in the form of farm woodlands and small forest properties, but the greater proportion occurs in large tracts that have been or are being logged by large lumber companies.

In many of the older cut-over areas in the longleaf type, where the smaller unmerchantable trees were left, natural reseeding to pine has taken place. There is ample proof throughout the longleaf country that natural reseeding to pine will take place wherever sufficient trees have been left as a source of seed. However, the amount and development of this new forest growth depend on a great number of other factors, and not alone on the presence of seed trees although this is necessarily a prerequisite.

More recent cuttings in the longleaf type have, as a rule, left few trees standing, and these but a scattering of the poorest suppressed trees of the virgin stand. Logging with steam skidders is common practice, and what few trees are not injured in the logging operation do not ordinarily escape further injuries from the ever-recurring grass fires. Such steam skidding and periodic burning has resulted in the denudation of extensive areas of longleaf forest land. As a result of current lumbering and turpentining practices and of fire, the South is confronted with its most important single forest problem; that of again making these longleaf pine lands productive. Just how this end can be attained, the particular measures necessary for growing another crop of timber, the financial possibilities of this land for forestry purposes, as well as a determination of the practices which might insure replacement of virgin stands now being harvested, present the basis for a number of the problems in the solution of which the Southern Forest Experiment Station is working. Many of the Station's investigations have a direct bearing on this important problem of reforesting these millions of barren or denuded acres.

In contrast to the conditions found in the longleaf pine territory, the shortleaf and loblolly pine types present no such serious problem of denudation caused by lumbering and fire. Shortleaf pine stands of original timber growth differed from the longleaf in the relatively greater abundance of trees of smaller size, with the result that more of a stand is left following logging operations. Seed years are more frequent and the seeds are more easily distributed and fly to greater distances than in the case of longleaf and slash pines. Also, fires are generally of less frequent occurrence in the shortleaf region. For these reasons, natural restocking to pine has been more general and forest destruction less frequent in the shortleaf region than in the longleaf.

Although the Station's investigations have been divided up under a number of main headings, it is often difficult to confine to a single heading the factors that must necessarily be considered under any one particular project. For instance, a study of the survival and growth of pine seedlings must take into consideration such a variety of influences as climatic conditions, soil, competing vegetation (including other seedlings, saplings, trees, brush, grasses, herbaceous vegetation), fire, grazing, insects, and diseases. These influences must be studied one at a time, or in very small groups, before it is possible to determine the effective treatment of trees or stands acted upon by all the factors at once.

The principal Station investigations which will be reported upon at this time are those that have a bearing on the problem of reforestation or the obtaining of maximum productivity of the forest lands in the southern pine region. Particular emphasis will be placed on the past year's work.

During the past year there have been a number of changes in the Station personnel caused by resignations and replacements. A number of new appointments have also been made by reason of increased appropriations for the current fiscal year beginning July 1, 1929. Because of the numerous changes in personnel, the progress of the Station program has necessarily suffered, inexperienced men having replaced those who left. There are at this time four vacancies on the permanent Station staff, all of which will probably be filled before the end of the year. The increase in personnel has necessitated more office space at the New Orleans headquarters. No suitable government-owned space being available, it was necessary to take commercial space. Present office quarters in the Stern Building are very well adapted to the Station's needs.

The centers of work near which most of the Station's permanent sample plots are concentrated are located at Urania, Louisiana (longleaf, shortleaf, loblolly pines); Bogalusa, Louisiana--McNeill, Mississippi (longleaf pine); Starke, Florida (longleaf, slash pines); and Valparaiso, Florida (longleaf pine). Recently the Station has inaugurated some studies on the Ouachita National Forest with headquarters at Hot Springs, Arkansas (shortleaf pine). Additional centers of work will be selected when increases in Station funds and personnel justify an expansion of the present program. In the meantime, information is being gathered as to the suitability of various locations for centers of work, so that a choice can better be made when such expansion seems justified.

The new studies begun this year have been made possible by an increase of $38,300 over and above last year's allotment of $43,900; $22,800 of the increase has been provided for the inauguration of economic studies of the financial aspects of timber growing in the southern pine region, $10,000 for investigations of the relation of forests to soil erosion, and $5,500 for additional naval stores studies. In addition to the regular Station appropriation, cooperative work is under way with the Bureau of Plant Industry, two forest pathologists being attached to the Station staff. During 1928 the State of Louisiana furnished a technical forester who worked under the direction of the Station on an investigation of the bottomland hardwoods in Louisiana. Material assistance in furthering various Station projects has been given by officials of the various State forestry departments in the South, by several timberland owners, and by many individual members of various units of the Forest Service and of other Government bureaus.

Fire Studies

The stress which is laid on fire damage studies can better be understood if it is realized that fire is overwhelmingly the most important factor in the failure of natural regeneration of pine stands in the South. Studies of fire damage, therefore, rank high on the Station program. The effect of fires on the four principal species of pine and under varying conditions are being investigated, both through intensive studies of successive fires on the seedlings from one particular seed crop and on stands of varying ages, and by extensive studies of cut-over lands through the South.

Fire is of such widespread occurrence in this section of the country that it enters into nearly every Station project in one way or another. Although no new fire projects were undertaken during the last year, reexaminations of the various fire study plots were made currently.

Intensive studies of fire damage are being carried on in eastern Texas, northern Louisiana, southern Mississippi, western Florida, and northeastern Florida by periodically observing the growth and development of pine seedlings and trees under conditions of controlled burning. A summary of the results of the various Station fire studies was prepared as an article for the May 1929 issue of "American Forests and Forest Life" under the title of "Fires and Forest Growth." Reprints of this paper have been given wide distribution in connection with the American Forestry Association's cooperative forest educational program in Georgia, Florida and Mississippi, as well as through the Station mailing list.

The preparation of a bulletin "Fires in the Southern Coastal Plain" is still in progress. Before the preparation of this bulletin could go forward to completion it has been necessary to analyse the old field data on fire damage taken during the course of the extensive surveys of cut-over lands in 1925 and each succeeding year. These data have now been worked up and the information relative to fire is being put into shape for use in this bulletin on fire.

The knowledge gained by a study of forest fire damage cannot fail to be of enormous value to timberland owners and to public agencies combatting fires. As a result of the Station fire studies, information will be made available that can be used as a basis for estimating the damage caused by fire. The various factors which influence the amount of damage are so numerous that it will be impossible to cover every possible combination of conditions. Among the factors which influence the effect of fire are the character, amount, condition, and distribution of the fuel (ground cover, logging slash, vegetation, number of years unburned); weather and climatic relationships (season of year, temperature, humidity, time of day, weather previous to and at time of fire); character of forest stand (density, type and composition of stand, size of trees and distribution, fire scars, turpentining); and topography.

The results of some of the Station's fire studies indicate very clearly the fact that pine seedlings in the early stages of their development are easily killed by fire, particularly when fires come during the growing season. Even stands 10 or 12 years old can be completely wiped out by summer fires. Fires coming during the winter season do not cause heavy mortality as do summer fires, but the effect of repeated winter fires on the development of forest trees, particularly in the seeding stage, is very marked. This has been strikingly demonstrated by the Roberts plots at Urania, where a quarter acre plot of longleaf pine seedlings has been subjected to repeated winter fires since 1915 when the seedlings were 15 months old. Trees on the unburned check plot average, at 15 years of age, more than twice as tall and twice the diameter of those on the burned plot.

A comprehensive study of the relation of fire and grazing to the establishment and survival of longleaf pine seedlings has been under way since 1923 at the McNeill, Mississippi branch station, in cooperation with the Coastal Plain Experiment Station.

Due to personnel changes it has not yet been possible to prepare progress reports on this experiment but the necessary field reexaminations are being made currently. A number of studies in which effects of fire on pine reproduction are involved, are located at the Camp Pinchot branch station in western Florida. In all of the Station's fire studies evidence has been obtained that shows conclusively the impracticability of attempting reforestation measures without providing for adequate protection from fire.

Management

These studies involve the determination of methods of handling stands of timber so as to obtain full yields of forest products as well as satisfactory natural reproduction on areas from which the mature timber crop may be harvested. If the forest land in the South is to be made fully productive it will be essential to have a clear picture of the cultural methods necessary to grow continuous crops of trees on the same land. Natural regeneration of new growth is easy to obtain where ample seed trees are present. The number, size, condition and distribution of seed trees necessary to insure ample restocking of the land offers a problem toward which a number of the Station's studies are directed. Many of the Station's findings have been included in a manuscript entitled "Timber Growing and Logging and Turpentining Practice in Southern Pine Region" prepared by the former Director of the Station, R. D. Forbes. This manuscript is now in the hands of the government printer and should be available for distribution at an early date.

Older cuttings in the southern pine region often demonstrate the feasibility of securing a new crop of forest trees from the seed produced by the scattering stand left behind the logging operation. Under changes in the market demands, more recent cuttings with steam skidders have brought about a system of cutting the land clean, particularly in the longleaf pine region. There still remains several years' cut of virgin pine timber ahead although the amount of timber cut each year from the original pine stands is gradually decreasing.

Station studies of natural reproduction of pine stands are under way at several points throughout the South, at or near the branch stations. Various method-of-cutting plots in virgin timber, cut-over and second-growth stands, have been laid out and records are being kept of the resulting reproduction. Other studies are designed to show the influence of soil, grazing, competing vegetation, turpentining, distance from source of seed, weather factors, etc. on the development of pine reproduction on cut-over lands. Some of these studies are in the form of permanent sample plots where reexaminations are made currently, while others are more extensive in character, representing the results of a single examination on temporary plots taken on typical areas where the history of the stand can be ascertained. It is recognized that many more studies of the factors involved in the success of natural regeneration of pine stands will be necessary before the Station will be in a position to give full information on this subject.

One of the most difficult problems confronting the Station is that of obtaining natural reproduction of pine on the deep sand lands of Florida. A considerable amount of work is under way on this project at the Camp Pinchot branch in western Florida, which cooperation has been made possible through the kindness of the National Forest administrative organization which is furnishing the Station with the services of a technical forester. These natural reproduction problems are most perplexing because there are so many factors involved. The isolation of these factors and a determination of the relative influence of each is not only one of the most urgent and most difficult of the Station's practical problems, but also an excellent opportunity to get at the fundamentals of the growth and development of pine seedlings. In these fundamental studies lies one of the most valuable functions which the Station can perform.

It is felt that many things can be learned through studies of trees in virgin stands under as nearly natural conditions as it is possible to obtain. To that end there is urgent need for setting aside areas where virgin conditions obtain so as to allow for future study. It should also be possible to observe the effects of various systems of management on present cuttings made in virgin timber stands, in the principal pine types.

In addition to the studies of natural reproduction just noted, other management projects under investigation by the Station include those on thinning of second-growth pine stands, the relation of the weather to seedling development. methods of eliminating undesirable or defective trees from the stand, the relation of root development of competing vegetation to pine seedlings and trees, and periodicity and amount of pine seed produced by trees of varying characteristics.

Forestation

As already stated, the problem of reforesting the millions of acres of denuded and understocked forest land in the South is considered one of paramount importance to the future well being of this entire region. The sections which can be reforested naturally will be saved an enormous amount of time and expense. There are, however, at least 10 million acres of longleaf pine land where new forest stands can be grown only by artificial measures. An additional area of 20 million acres is producing but a fraction of its possible forest growth, which can be increased substantially only by forest planting. The demand for information on nursery and planting practices becomes more pronounced each year as the acreage planted to forest tree seedlings in the South increases.

The Southern Station program has included forestation studies in its program since its inception. The carrying out of these studies has been due in no small part to the cooperation of the Great Southern Lumber Company at Bogalusa, Louisiana, where most of the tests have been made. During the last year three Station publications dealing with forestation have appeared; two as U. S. Department of Agriculture leaflets under the titles "Planting Southern Pine" and "Producing Pine Nursery Stock in the South." These leaflets contain pertinent information and recommendations for forestation practices, based on the experience and results of the Station's field and nursery tests. The other publication, "Survival and Early Growth of Planted Southern Pine in Southeastern Louisiana," appeared as a Louisiana State University bulletin, and embodied the results of extensive examinations of the plantations of the Great Southern Lumber Company.

It has been amply demonstrated on a commercial basis that artificial reforestation is possible in the South and can be accomplished at reasonable expense. There are a number of additional investigations on artificial forestation which might well be undertaken at some future time. For instance, no successful method has been found for holding over longleaf seed to be used for planting in the poor seed years which normally follow good seed crops. The Station has a number of valuable leads but cannot carry on a comprehensive test at the present time.

The Station has had one man spending practically his entire time on forestation projects ever since the Station was established. Current reexaminations of the Station's plantations, making the necessary seed germination tests currently, carrying on a few storage tests, and putting into shape for publication a considerable amount of field data has been the main program in the forestation work during the last year.

A few additional forest plantings were made at the Camp Pinchot branch station in western Florida during the year. A number of exotic species are being given a trial, but on a very small scale, necessitating little time of the Station staff. It is believed that the most urgent forestation research needs of the Station have already been met and that few additional studies will be justified for some time to come. The forestation program of the Southern Station should, therefore, show no expansion. It may be advisable to observe currently the main commercial forestation projects throughout the South.

Grazing Studies

That there are other factors involved in the use of forest land than the growing of tree crops has been recognized in the Station project established at McNeill, Mississippi in 1923. There the possibility of combining timber growing and cattle raising on the same land is being tried out, in cooperation with the Coastal Plain Experiment Station. If the immense area of idle land in the South can be utilized for this dual purpose, it will give additional promise of the commercial possibilities of both forestry and cattle raising by furnishing an additional source of income at least while the trees are immature.

On the 320-acre experimental area in cut-over longleaf pine land in southern Mississippi, cattle are being grazed on native grass pasture at the rate of one head per 7½ acres, which, after having tried one head per 10 acres for 5 years and one head per 5 acres for 1 year, has been found to be about the optimum stocking of cattle for proper utilization of the range. Half of the area is burned over every winter while the other half has been given continuous protection from fire. Two 10-acre check plots have been kept ungrazed. Scattered over this area a number of small plots have been staked out on which an intensive study of the longleaf pine seedlings is being made. These studies have been confined to the seed crops of 1924 and 1927 which have come from the stand of longleaf pine seed trees averaging 12 per acre which were left in the logging about 25 years ago.

The results thus far seem to indicate that cattle grazing and timber growing can be practiced on the same land, particularly where fires are kept out, and if overgrazing is guarded against. This applies only to the native grass lands and not to improved pastures such as those of carpet grass and lespedeza. Cattle grazing should be a profitable enterprise until the trees reach merchantable size.

Forest Measurements

A knowledge of the rate of growth of forest trees is essential to any well-ordered management of land for timber production. Not only are volume tables needed to show the average contents of trees of different sizes but, in order to predict the future productivity of forest land, it is essential to have accurate information as to how great a volume of wood can be produced on different soils in periods of years.

Studies of the rate of growth of second-growth stands of the four southern pines were completed some time ago and the results made available in mimeographed form pending final publication as a Government bulletin. According to recent advice from Washington this publication, "Volume, Yield and Stand Tables for Second-Growth Southern Pines," is expected to be ready for distribution about November 1, 1929. The information in this bulletin should prove of immense value to owners of pine timber lands in the South because it will enable them to determine the timber growing possibilities on their forest land. It will consist in large part of tables setting forth the number of cords of pulpwood or board feet of lumber in trees of different size and in stands of given age grown on soils of varying productive capacity. Although these tables apply primarily to even-aged stands growing at average maximum capacity they give a picture of the possibilities of reforestation in the southern pine region.

In comparison with other important timber species in the country, the southern pines as a group rank among the most rapid growing. With decreasing timber supplies and increase in stumpage prices the South will undoubtedly take high rank in supplying the future timber needs of the country. The growth studies and their application to existing stands, therefore, form an important part of the Station program.

Naval Stores

The production of naval stores (obtained from the distillation of pine gum) in the southeastern United States is an industry which in that region is exceeded in importance only by agriculture and lumbering. The entire United States production comes from these southern states and in 1928 this amounted to 65 per cent of the total world's production. The center of the naval stores industry lies in the region where the most extensive stands of second-growth longleaf and slash pine are found, in Georgia and Florida, but its possibilities extend over the entire range of these two species of Southern pines. The advantages which the naval stores industry offers is an additional favorable factor in the economic possibilities of reforestation in the South. Because the turpentine pines reach a size large enough for economical naval stores production in from 15 to 25 years, on the average, early and intermediate financial returns are possible. Furthermore, with conservative methods of working for naval stores the future value of these trees for saw timber and other forest products will not be appreciably impaired.

Present methods of extracting the gum are usually wasteful and economically unsound when it is considered that sustained production is possible under proper management. One of the most deplorable phases of present day naval stores practice is that of chipping half-grown trees. This not only ruins these trees for future naval stores production but has resulted in increasing the costs of production and at the same time reducing prices by increasing the present supply, to a point where profits are almost negligible.

The Southern Station's naval stores research program, which has been under way since 1923, centered at the Starke, Florida branch aims to determine those methods of turpentining which will assure continuous growth of the trees and replacement of the stands and at the same time give maximum yields of gum commensurate with the development of trees for other products.

Among the investigations under way are modifications of methods of chipping to determine the type best suited to conserve timber and increase gum yields. These studies deal with depth and width of streak, width of face, and type of tool used. French methods have been compared with American and new types of tools have been developed. Another group of investigations has to do with the relation of gum yield to size of tree, density and age of stand, and weather conditions. Most of the studies have been centered at the Starke, Florida branch but some of the experiments have been duplicated at the Camp Pinchot branch station and in Southern Mississippi.

The results of the Station studies will be put out as a Government bulletin, the preparation of which has been under way for some time. Many of the preliminary results have been made available in miscellaneous progress reports and through contacts between the Station and the Naval Stores industry. During the last year the Station put out a bulletin, "Florida Naval Stores," in cooperation with the Florida Department of Agriculture. This publication presents general information on the naval stores industry in Florida and summarizes briefly many of the preliminary results of the Station's investigations.

An increase in this year's appropriations for naval stores studies has been used to increase the technical staff. This should make possible more rapid progress in working up the results of old field data for early publication. To this end a statistical clerk is being assigned to the Station branch. With the additional personnel, plans are also being made to inaugurate a study of the management of stands of different density for the production of naval stores.

The Station's naval stores studies have shown that gum yields increase with size of tree and that small trees can not be profitably worked; that conservative chipping practices result in increased gum yields, longer working life for the operation, and better tree growth; that open-grown trees yield better than those in dense stands; and that temperature has a decided effect on gum yield.

Cross-pollination of trees of high yielding capacity was begun in February, 1929 in cooperation with the Washington office to get seed for use in a source-of-seed study. Studies of the life history and damage of the turpentine borer have been made in cooperation with the Bureau of Entomology. Gum samples from the various Station tests are being analyzed by the Bureau of Chemistry and Soils at Washington. The Station has enjoyed the cooperation of a number of other Government, State, and private agencies in the conduct of the general naval stores program.

Pathology

Through the assignment of two pathologists to the Station staff from the Bureau of Plant Industry, it has been possible to undertake investigations of the diseases of forest trees and of forest products. The forest pathologist has worked almost entirely on a disease known as the brown-spot needle blight (Septoria acicola), which causes very serious damage to longleaf pine in the seedling stage. It has been demonstrated that the disease can be controlled by spraying with either Bordeaux or lime-sulphur, and practical application of these measures is certain to be an important factor in controlling this disease in nurseries of forest seedlings, thus assuring better grades of planting stock. That fire will not control this disease was indicated by the fact that infection was more severe the second season on an area burned the previous year than on one unburned for a number of years, even though there is less infection during the season immediately following a fire.

Forest products pathology work has been limited to a study of the sap-stain and mold problem, the importance of which was brought out by a preliminary survey of mill conditions in the South. Soda dipping at mills has not always given satisfactory results, and although this may not always have been due to the fault of the method, it was desired to make a thorough test of other chemicals before recommending any specific treatment as being the best. The use of soda has the objectionable feature of discoloring the lumber, and it was believed that some other chemical might be found more satisfactory. Small scale dipping tests were run, therefore, at three southern mills and the effectiveness of 23 chemicals or combinations of chemicals tried out. These preliminary tests were made to serve as a means of eliminating the least effective from further tests which are to be made with commercial-sized piles of lumber. Several chemicals were found to have approximately the same degree of effectiveness as soda in preventing stain and mold in pine and are far superior to soda on sap gum.

Economic Studies

A substantial increase was allotted to the Southern Station this fiscal year for the purpose of initiating investigations of the financial aspects of timber growing in the southern pine region. This new work will involve a consideration of the economic factors bearing on the opportunity for profit through forestry practice under various conditions. The study will necessitate investigations of local timber supplies, consumption of forest products, transportation factors, trend of timber values, and the probable costs and returns from the practice of forestry. If the findings are adverse it will be just as essential to make it known as to stress only the factors favorable to a forestry business.

In order to obtain the basic data for the study and to more effectively cover the field, the Station will need the whole-hearted cooperation of a great number of timberland owners, from the farmer with the small piece of woodland to the largest forest industries.

It is estimated that the farm timberland holdings in the South represent, at the present time, one-third of the area and one-half of the total annual cut of southern pine. Farm forestry, therefore, represents a very important factor in the future timber production of the South. Small forest properties will be considered in groups by making separate county studies in the different timber types, selecting for study counties which are representative of a principal pine type and kind of product. It will also be necessary to consider the place of the farm woodland in the general farm land management. The initial study of small farm properties in the South has already been undertaken, and the first draft of the report was recently completed. Alcorn County, Mississippi, in the extreme northeast corner of that State, was selected for the first study as being typical of the shortleaf pine-hardwood region where the product is entirely dimension material cut in small mills of a portable or semi-portable type.

Large lumber companies or forest industries interested in the possibilities of forestry practice will be invited to cooperate in studying the financial aspects of southern pine forestry undertakings, with the complete assurance that figures for any particular property will be kept strictly confidential. Although no two timber properties are exactly alike, it is quite possible to apply average figures to certain types of forest holdings. The cooperation of those forward-looking concerns that are planning on sustained yield operations will enable the Station to constructively analyze the economic possibilities and future prospects of timber growing in this region.

Aside from the financial aspects of private forestry operations, due consideration will be given to the prospects for public participation in looking toward the future timber production in this region.

The study is in direct charge of Dr. E. A. Ziegler, Senior Forest Economist, formerly Director of Pennsylvania State Forest School at Mont Alto. He will be assisted by a staff of at least three men, not all of whom have yet been selected.

Erosion Studies

The relation of forest cover to soil erosion is a subject upon which very little exact information is available. The importance of forests in the control of floods and excessive soil washing has not been generally recognized, although it was forcefully brought to the Station's attention in connection with a study of the relation of forests to floods in the lower Mississippi Valley following the extreme high water in 1927. The report prepared at that time has been included in the comprehensive House of Representatives Document No. 573, 70th Congress, 2d Session, "Relation of Forestry to the Control of Floods in the Mississippi Valley."

A preliminary survey of the subject at that time indicated that the area of most serious erosion in the region under consideration was located in the silt loam uplands (loess formation) east of the Mississippi and south of the Ohio Rivers, an area roughly 500 miles long and 50 to 75 miles wide. In order to investigate the soil erosion problem in this region and to devise means of prevention or control of destructive erosion, the sum of $10,000 was made available to the Station this fiscal year. The first studies are now under way in northern Mississippi with two technical men assigned to the project. The preliminary survey will aim to determine what artificial or natural measures of control have led to the best results. At a later date more intensive studies of the relation of forest growth to erosion will be undertaken and the best species of plants for revegetating eroded lands determined. The progress of this project will depend to a large extent on receiving the close cooperation of state, county and private agencies.

Hardwoods

Between one-third and one-half of the total production of hardwoods in the United States comes from the bottomland forests of the southern states, principally those bordering on the Mississippi River. This region covers an area upward of 30 million acres and represents one of the most important fields in southern forestry. The Southern Station has done no work in this region other than to supervise an investigation of the possibilities of hardwood forestry in Louisiana, which was financed by the Louisiana Division of Forestry in 1928. A summary of the first year's investigations as published in the Journal of Forestry in May, 1929 pointed the way to the need for further investigations in the southern hardwood region. Detailed studies of logging costs, growth and methods of cutting were stressed as being particularly urgent if hardwood timberland owners are to be interested in practicing forestry on their lands. It is felt that such investigations would go a long way in the development of this important phase of southern forestry.

Proposed Work

Handicapped to a certain extent by the frequent changes in personnel, a certain amount of discontinuity in the regular progress of the Station's program has resulted. A considerable volume of old field data for a number of the Station projects will be put into shape for publication before additional work is taken on. The newer projects made possible by recent increased funds have few precedents as guides and must be worked out for the most part along lines to be developed as the investigations progress. The reexamination of the Station's permanent sample plots and the preparation of progress and final reports on certain phases of the work will necessarily take up the greater proportion of the time of the regular staff during the ensuing year. Extensive surveys of the cut-over lands in the region have served in the past as a means of acquainting the newer members of the staff with the region and at the same time information of value in working out many of the forest management problems in the southern pines has been secured. These surveys should be continued to the extent that time and finances will permit.

Fire Studies

Work on the manuscript on "Forest Fires in the Southern Coastal Plain" will be given preference over all but the most urgent of the Director's duties. Now that all the old extensive survey field notes on fire have been put into usable form, work on this manuscript should progress rapidly.

The effects of fire are being studied in connection with a number of other Station projects, necessitating annual or periodic burning over of plots. These phases of fire damage will be continued as at present, including among others such investigations as the effect of fire on the chemical and physical constituents of the soil.

Management

Before the original growth of pine forest has been entirely cut over in the South the Station should establish series of plots in each principal pine type to study methods of natural reforestation under various systems of management. If these studies are not begun within the next few years the opportunity will be lost. With this idea in mind the Station is arranging with various operators of virgin pine timber, with the administrators of the national forests in the South as well as with certain lumber companies, to cooperate in the establishment of method-of-cutting plots. It is planned to put in at least one of these series of plots each year.

Additional thinning plots are urgently needed to fill out the gaps in the present program and these will be put in whenever the opportunity is offered, depending on the availability of Station personnel.

In the establishment of any new thinning plots, as well as when any further thinnings are made on the plots already established, the Station will cooperate with the Section of Silvicultural Relations of the Forest Products Laboratory in studying the relation of tree growth to density of stand, particularly as it relates to the quality of the wood found under varying stand densities. A number of thinning plots are due to be remeasured during the coming field season and some additional thinning will probably be found necessary at that time.

Forestation

No new forestation projects are contemplated for the coming year. The analysis of a mass of old data is going forward and necessitates a considerable amount of compilation which is being facilitated by use of punch cards. In the preparation of the formal manuscript to include the results of the Station's forestation work to date it is deemed advisable to work up parts of the data as short articles and notes that can be published currently.

Plans will be drawn up for seed storage tests to be undertaken at some future date when the opportunity is presented. It is felt that a comprehensive seed storage test is needed to round out the Station's forestation projects. Several commercial forest nurseries in the South will be visited during the coming year.

Grazing Studies

It is planned to go further into the analysis of the various factors entering into the survival of longleaf pine seedlings on the McNeill experimental area than has been possible heretofore. Tests of the physical and chemical composition of the soil and studies of the soil microflora under the various conditions represented on the grazing study plots will be undertaken in cooperation with chemists and soil bacteriologists at the State Agricultural College in Mississippi. Intensive studies of the succession of plants on these plots will also be undertaken.

Measurements

The establishment of a number of permanent yield plots in second-growth pine stands of varying degrees of stocking is contemplated, to be undertaken near the branch stations. A number of suitable stands near Urania have already been tentatively located and if possible the plots will be laid out during the coming field season. At the same time it will be possible to obtain a check on the application of the second-growth southern pine growth tables to understocked stands.

Naval Stores

Field work on all of the current naval stores projects will be renewed next season. Every effort will be made to complete the analysis of old field data at an early date. The appointment of a statistical clerk to the Starke branch will be made effective in the near future and this should help very materially to hasten the completion of the large naval stores bulletin.

The only new work contemplated in naval stores investigations is a study of the relation of gum yields to density of stand, the density to be controlled by thinning several plots to varying densities. The plots will be laid out in a densely stocked even-aged longleaf pine stand. Trees under 4 inches in diameter will be cut out at once; larger trees that are selected for removal will first be worked for naval stores. The effect of the thinning will be measured in tree growth and in gum yield during the period of years that this test will run.

Pathology

The study of the brown-spot needle blight of longleaf pine will continue as the principal project of the forest pathologist. Inoculation work and taxonomic and histologic studies of this fungus will be conducted in the laboratory at headquarters. A series of brush-disposal plots will be established on the Ouachita National Forest in Arkansas to follow through the decay of logging slash under various systems of treatment. The amount and extent of infection of the butt logs of shortleaf pine with the common butt rot (Polyporus schweinitzii) will also be studied.

Work in forest products pathology will center on the large scale dipping experiments to determine the relative efficiency of a few of the chemicals which showed up most favorably in the small tests recently completed. These commercial scale dipping tests will be conducted at three to five large southern pine mills in various parts of the South. Experiments with end coatings and sprays of logs for the prevention of stain and decay in logs during storage are contemplated at one or two mills. Various phases of the stain problem in export lumber may be investigated if cooperative funds are secured.

Economic Studies

The study of the financial aspects of timber growing in the southern pine region will be divided into two parts. The first will entail surveys of typical counties in various parts of the region to obtain first hand information on the present condition of small forest properties such as farm woodlands, and to determine the position which these farm forests occupy in the production of forest products for the country. A separate report will be prepared for each county and an attempt will be made to have these published as soon after completion as possible and by cooperative agencies. The other part of the economics study will consider the financial possibilities of growing timber by large lumber companies or by public agencies. These studies will necessitate the cooperation of a number of owners of large timberland properties and in particular those planning on obtaining continuous yields of forest products. The data obtained from individual owners will be held strictly confidential and used only in averaging figures from a number of similar forestry undertakings in the region.

Erosion Studies

The initial studies will aim to obtain information as to the location of the most seriously eroded areas in the silt loam upland region of Mississippi, and to determine, if possible, the artificial and natural measures of control which have seemingly led to the best results. More intensive studies of the relation of forest cover to erosion will be initiated at a later date. The results of the first season's preliminary investigations will be put in the form of a report which may be suitable for publication.

Hardwoods

No hardwood studies are contemplated in the regular Station program until such time as funds may be made available for this purpose.

Other Studies

The place of forest insects and wild life in the management of lands for forest production in this region is little understood. An entomologist and biologist are badly needed to round out the Station's staff.

Articles Submitted for Publication
October 16, 1928 to October 15, 1929

* * *

Demmon	"What the Forest Fires of 1927 Did to the Pines on Georgia Cut-Over Lands" - Weekly Naval Stores Review, Dec.1, 1928.
	"Forest Research in the South" - Southern Lumberman, December 22, 1928.
	"Forests Needed to Restore Eroded Mississippi Bluff Land" - Forest Worker, January, 1929.
	"Reforestation as Related to Louisiana's Future Development" - Southern Lumberman, January 12, 1929, and Lumber Trade Journal, August 1, 1929.
	"Fires and Forest Growth" - American Forests and Forest Life, May, 1929.
	"The Relation of Forest Research to the Naval Stores Industry" To be submitted to the Pine Institute of America for publication. June, 1929.
	"A Method of Determining the Timber Yielding Capacity of Southern Pine Soils" - Lumber Trade Journal and Southern Lumberman. July 15, 1929.
Wyman	"Conservative Turpentining the Key to Forest Prosperity" - Southern Lumberman, December 22, 1928.
	"Naval Stores Research" - Annual publication of Syracuse Forest School. January, 1929.
	"Factors Which Influence Yield of Gum and Other Forest Products" - Get-Together Conference of Pine Institute of America, February, 20-22, 1929.
	"Florida Naval Stores" - Bulletin 25, Florida Department of Agriculture, May, 1929.
	"The Contribution of the United States Forest Service to the Naval Stores Industry" - Naval Stores Review, Oct.5, 1929.
Pessin	"Timber Growing Combined with Cattle Raising on Cut-Over Land in the South" - Submitted for Department of Agriculture Yearbook. June, 1929.
Wakeley	"Testing the Quality of Pine Seed" - Southern Lumberman, December 22, 1928.
	"Planting Southern Pine" - U. S. Department of Agriculture Leaflet 32. April, 1929.

Wakeley (cont'd)	"Producing Pine Nursery Stock in the South" - U. S. Department of Agriculture Leaflet 35. April, 1929.
	"Improving the Grade of Southern Pine Planting Stock" - Submitted for Department of Agriculture Yearbook. June, 1929.
	"A Fool-Proof Method of Planting Longleaf Pine Seedlings" - Submitted to Forest Worker, September 27, 1929.
Wakeley & Hayes	"Survival and Early Growth of Planted Southern Pines" - Louisiana State University Bulletin, Vol.21, No.3, Pt.2. May, 1929.
Barrett	"Accuracy of Forest Service Standard Hypsometer" - Journal of Forestry, May, 1929.
	"Increased Growth of Longleaf Pine Left After Logging" - Southern Lumberman, April 20, 1929.
Barrett & Righter	"Working Plan for Experimental Thinnings in Shortleaf and Loblolly Pines" - Submitted to Journal of Forestry: to be published November, 1929.
Righter	"A More Scientific Method of Experimental Thinnings" - Journal of Forestry, March, 1929.
Lentz	"Report of the Mississippi Valley Hardwood Investigation" Proceedings of Eleventh Southern Forestry Congress, April, 1929.
	"Summary of First Year's Hardwood Investigations in Louisiana" - Journal of Forestry, May, 1929.
	"Louisiana Hardwood Lands Offer Exceptional Opportunities for Timber Growing" - Forest Worker, May, 1929.
Putnam	"Butt Swell in Southern Swamp Hardwoods" - Southern Lumberman, December 22, 1928.
	"The Occurrence of Heartwood and Figure in Red Gum" - Southern Lumberman, December 22, 1928.
Lindgren	"Sap Stain and Mold Control at Southern Mills" - Southern Lumberman, September 1, 1929.
Gemmer	"Forest Plantation Experiments on the Choctawhatchee National Forest" - Journal of Forestry, December, 1928.
	"Method of Recording Maximum and Minimum Temperatures of Forest Soils" - To be published in Science, November, 1929.
Vining	"Damage Resulting From Recent Florida Hurricane to Second Growth Turpentine Timber" - Weekly Naval Stores Review, December 15, 1928.

A13.27.

1930

TENTH ANNUAL REPORT AND PROGRAM

# of the

SOUTHERN FOREST EXPERIMENT STATION

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
SOUTHERN FOREST EXPERIMENT STATION
NEW ORLEANS, LOUISIANA

Oct. 15, 1930

STAFF
SOUTHERN FOREST EXPERIMENT STATION
1929-1930

E. L. Demmon	Director
E. A. Ziegler	Senior Forest Economist
W. E. Bond	Forest Economist
G. H. Lentz	Silviculturist
W. G. Wahlenberg	Associate Silviculturist
P. C. Wakeley	Associate Silviculturist
Lenthall Wyman	Associate Silviculturist
L. J. Pessin	Associate Forest Ecologist
P. V. Siggers (Bureau of Plant Industry)	Associate Pathologist
J. D. Sinclair	Assistant Forest Ecologist
J. L. Averell	Assistant Silviculturist
Henry Bull	Assistant Silviculturist
E. W. Gemmer	Assistant Silviculturist
V. L. Harper	Assistant Silviculturist
N. T. Mirov (Resigned Dec. 15, 1929)	Assistant Silviculturist
R. K. Winters	Assistant Silviculturist
R. M. Lindgren (Bureau of Plant Industry)	Assistant Pathologist
R. A. Chapman	Junior Forester
J. W. Cruikshank	Junior Forester
F. D. Heyward	Junior Forester
H. G. Meginnis	Junior Forester
C. F. Olsen	Junior Forester
R. R. Reynolds	Junior Forester
P. O. Rudolf	Junior Forester
A. R. Spillers	Junior Forester
T. N. Busch	Assistant Forest Ranger
R. M. Barnette (Florida Agricultural Experiment Station)- -	Agent
John W. Lubbe	Junior Administrative Assistant
Vera M. Spuhler	Senior Clerk
Effie C. Herndon	Clerk-Stenographer
Bettie Chamberlain	Clerk (Statistical)
Mary C. Regan	Assistant Clerk-Operative
Camelia M. Larsen	Assistant Clerk-Stenographer
Agnes G. Terburg (In Cooperation with District Forest Inspector)	Assistant Clerk-Stenographer
Elizabeth Bergland	Junior Clerk-Stenographer
Ruth Marshall	Junior Clerk-Stenographer
Pearle H. Morris	Junior Clerk-Stenographer
May M. Patchett	Junior Clerk-Stenographer

Temporary Field Assistants

W. C. Bramble (Pathology)
F. W. Bennett
Dale Chapman (Pathology)
T. S. Coile
J. C. Craig
J. D. Diller
G. W. Genth
L. D. Glenn (Pathology)
R. W. Hayes
R. H. May
Theodore Scheffer (Pathology)

Vacancies on October 15, 1930 - Forest Survey - Regional Director, Forest Economist, Junior Forester.

R
Investigations
Program

November 1, 1930

TENTH ANNUAL REPORT
of
SOUTHERN FOREST EXPERIMENT STATION
October 16, 1929 to October 15, 1930

Previous annual reports of the Station have reviewed in considerable detail the forestry problems in the southern United States. This region, with its great variety of native trees valuable for timber and other forest products, its relatively easy logging conditions, its long growing season, abundant rainfall and a vast area of land available for forest growth, and relative proximity to the greatest timber market in the world, is better situated for the development of forestry than any other section of the United States. The broad purpose of the Station is to work out the basic facts needed to obtain the most economical use of land for the production of timber and other forest crops in this region. Last year's report stressed the important problem of reforesting the millions of acres of non-productive cut-over longleaf pine lands of the South Until this year, the Station's efforts have been concentrated on the pine region, because this represents a much greater land area than the other major timber type in the South, the hardwoods. Inasmuch as certain studies on the southern hardwood type have been initiated for the first time this year, it seems opportune to review briefly at this time the scope of the hardwood problem in the South.

Less is known about the southern hardwoods than about any other major forest region in the country. The economic importance of this region can be gauged by the fact that over one-half of the total hardwood production of the country comes from the southern states, and principally from that part of the Mississippi River bottomlands known as the Delta. This district, together with the alluvial lands along all the rivers flowing through the Gulf and Atlantic Coastal Plain, comprises in the aggregate an area of upwards of 30 millions of acres.

It has been the general consensus of opinion that these hardwood forests contained almost unlimited reserves sufficient to provide a large proportion of the nation's hardwood needs for many years to come. The high fertility of these bottomland soils, where formerly stood a magnificent forest of hardwood trees, is well known to all who are familiar with agricultural development in the Mississippi River valley, with as productive farm land as can be found anywhere in the world. Of recent years, however, the amount of new land developed for agriculture has steadily declined, and the area of cut-over hardwood land has correspondingly increased. Logging off of the original stand of virgin hardwood timber has even continued at an accelerated pace. Recent extensive investigations indicate that, instead of containing limitless reserve supplies, these forests are in reality already very seriously depleted.

In the face of a world-wide agricultural depression any early development of these fertile cut-over hardwood lands will, without doubt, prove economically impracticable. In the meantime, here are many millions of acres of potentially productive land yielding little or no income, with corresponding detrimental results to many communities as well as to the region as a whole. What more logical use presents itself than to grow new crops of forest trees on these lands?

Much of the bottomland hardwood region and particularly many forested or cut-over parts of it are wet most of the year, or at best are subject to periodic overflow. It is not unlikely that portions of this region may eventually be used for reservoir or spillway development in connection with the Mississippi River Flood Control Program. However, there is good reason to believe that very considerable areas of this land will for many years continue to lie idle, following the harvesting of the forest crop.

An extensive survey of the hardwood bottomlands of Louisiana was made in 1928 by the Southern Station, with funds furnished by the Louisiana Department of Conservation. That survey revealed the growing scarcity of virgin hardwood timber, the common occurrence of deterioration in hardwood stands brought about by fire, decay and wasteful cutting methods, and in particular the consistent disregard given to the possibilities of producing future timber crops on land from which the original timber had been cut. The almost entire lack of fire protective measures in the hardwood region was striking when the damage caused by fire stood out so prominently.

A few examples of excellent forest growth possibilities were found on this extensive survey, and these examples give promise of what may be expected under proper management for timber production. As a rule, however, cut-over stands were found to be in such a state of neglect and misuse that the prospects for profitable reforestation appeared slender indeed.

Until recently, the Station has been unable to initiate any intensive studies in the southern hardwoods.

At the last session of Congress, however, the importance of having more definite information on the southern hardwood region was recognized by providing for this purpose an increase of $35,500 in the current year's appropriations for forest research at the Southern Station. Of this amount, $10,500 is allotted for the specific purpose of making growth studies in existing hardwood stands. Two technical foresters have been assigned to this project and have already begun to collect field data. The results of this investigation will have a very practical value in that they will give definite information on the timber productive possibilities of hardwood lands under the general prevailing conditions, as compared with the growth possibilities under intensive forest management. The studies will also furnish part of the information for a compilation of existing and probable future growth in the bottomland hardwood forests of the entire South. The growth data obtained in the field will be used in the preparation of tables to show the contents of trees of different species and of varying sizes (volume tables), as well as the productive capacity of the land in terms of quantity of standing timber in fully-stocked stands at different ages (yield tables).

A sum of $25,000 was also appropriated by the last Congress for the purpose of initiating a forest survey in the southern hardwood region. This is part of a nation-wide survey authorized by the McSweeney-McNary Forest Research Act of 1928. The first work on the nation-wide survey was begun in the Pacific Northwest last year. From this survey will come the first complete and accurate picture ever had of the forest situation and forest needs of the nation. The various forest regions, of which the southern hardwood is one, are to be studied separately. Because of its importance from a national standpoint and because so little definite information exists relative to the southern hardwoods, this region was the second in the entire country to be selected for study under this project. The Survey will consist of an inventory of timber resources, the rate of their depletion, and a study of the future timber requirements. It will necessitate a determination of the volume, quality and location of remaining timber stands, the acreage of lands covered (for each broad type of forest cover); the current rate at which these forests are growing, as well as the rate at which they are being depleted by cutting, fire, insects, diseases, or otherwise; the potential growing capacity of the region, and the present and probable future national requirements of the forest products of the region. A staff is now being recruited for this work. The details of how the field work under the Forest Survey will be conducted will be guided largely by the conditions encountered, although the experience gained through the first studies in the Northwest should be profitable. However, conditions in the southern hardwood region are so different from those found in any other major forest region in the United States that we may have to base our methods largely upon our own experience in the field.

General

The Southern Forest Experiment Station, one of eleven regional forest experiment stations in the United States, was established July 1, 1921 for the purpose of ascertaining the best methods of growing timber crops and for promoting the full use of the forest lands in the southern United States for the production of timber and other forest crops. The territory served by the Station includes part of or all of eight southern states: Florida, Georgia, Alabama, Mississippi, Louisiana, and Arkansas and the timbered portions of Oklahoma and Texas, and aggregates 200 million acres of forest or other land suited to timber-growing.

The principal forest regions in this territory are: (1) the longleaf pine (including slash pine), 78 million acres, of which 78 per cent is in timber or available for timber-growing at the present time; (2) the shortleaf pine region (including loblolly pine and some upland hardwoods), with approximately the same total area and the same proportion available for timber growth as the longleaf region, and (3) the hardwood region, mostly bottomland hardwoods, including a great variety of species, 46 million acres, of which 68 per cent is available for forest growth at the present time.

Distribution of Expenditures by Lines of Work, Fiscal Year 1930.

Project	Allotment	Expenditure	Percentage of total
Silvicultural Investigations	$49,500.00*		
Protection, fire	—	$ 2,353.57	3
Measurements	—	943.62	1
Management	—	17,074.45	21
Naval Stores	—	19,536.61	24
Protection, other	—	3,559.41	4
Forestation	—	6,030.25	7
Erosion	10,000.00	9,999.79	12
Economic Studies			
Financial Aspects of Forestry	22,962.56	22,961.65	28
	$82,462.56	$82,459.35	100

*Includes $300.00 item from a separate appropriation for Equipment and Supplies, but excludes $200.00 which was transferred to Region 7 to finance part of the salary of Junior Forester E. W. Gemmer. The balance of Gemmer's salary was paid by Region 7, although he spent practically full time on Southern Station work.

Allotment Fiscal Year 1931

Silvicultural Investigations	$ 78,650.00
Erosion	10,000.00
Economics	
Financial Aspects of Forestry	22,800.00
Forest Survey	23,500.00
Equipment and Supplies	350.00
TOTAL...............	$135,300.00

Among the increased Federal appropriations made available to the Southern Station this fiscal year (1931) are the following: $25,000 for the initiation of the Forest Survey in the southern Bottomland hardwood region; $10,500 for growth and yield studies in the bottomland hardwoods; $10,000 for investigations of the relationships between fire and resin yields in naval stores operations; and $10,000 for investigations of methods of cutting to insure natural reforestation in second-growth yellow pine stands. Small reductions have been made in these appropriations to cover overhead at the Washington office.

In addition to these regular Station allotments, cooperation is carried on with the Bureau of Plant Industry, whereby two forest pathologists are assigned to the Station staff. Considerable assistance in the form of temporary help has been furnished by a number of State Forestry Departments in the South. The Station has the advantage of close cooperation with a great number of Federal, state and private agencies throughout the southern region.

Personnel

A considerable enlargement of the Station staff has taken place during the last few months. At the present time, there are twenty-four men on the permanent technical staff, with three additional places not yet filled, a clerical force of eleven people, and a number of technical field assistants under temporary assignments.

Centers of Work

There are at present five branch field stations, where practically all of the Station's permanent investigative plots are centered. Location, date of establishment and principal forest type represented at each branch station are as follows:

Urania, Louisiana (1921). Shortleaf and loblolly pines.
Bogalusa, Louisiana, (1921), McNeill, Mississippi (1923). Longleaf pine.
Valparaiso, Florida, Choctawhatchee National Forest (1927). Longleaf pine.
Starke, Florida, naval stores station (1923). Longleaf and slash pine.
Hot Springs, Arkansas, Ouachita National Forest (1929). Shortleaf pine.

The need is recognized for the setting aside of experimental forests at these or other centers of work, so that the Station's field plots can be permanently located for intensive research and demonstration, with the assurance that the resources of men and money can be most effectively utilized. Recommendations have been made for the acquisition of tracts of land for this purpose. One of these tracts is situated adjacent to the Osceola National Forest in Florida, and is urgently needed to take care of our future naval stores investigations. The possibilities of locating suitable experimental forests on the Catahcula National Forest in Louisiana and on the Ouachita National Forest in Arkansas have been considered, and some preliminary reconnaissances have been made to that end.

Plans are also under way to select certain areas of virgin forest which can be set aside as Natural Areas. The purpose of these Natural Areas is to permanently preserve in an unmodified condition areas representative of the virgin growth of each important forest type, so that its characteristic plant and animal life and soil conditions shall be available for purposes of science, research and education. The virgin forests of the South are rapidly disappearing under the saw. It is hoped that before they are entirely gone, certain tracts may be set aside, either from existing National Forests or by their acquisition by gift, exchange or purchase. A virgin longleaf pine area within the Kisatchie National Forest purchase unit in Louisiana has been recommended as suitable for a Natural Area. Selection of tentative virgin areas on the Ouachita and Choctawhatchee National Forests for this purpose is being made in cooperation with the District Administrative Organization.

Fire Studies

Because forest fires are of such common occurrence in the South, the influence of fire touches many of the problems under investigation by the Southern Station, including studies of cone production, naval stores yields, seedling establishment and survival, grazing, and plant succession.

Fires are of more widespread occurrence in the South than in any other part of the United States; the damage they cause is enormous in the aggregate, although they are generally of the ground or grass fire type, which is not as spectacular, nor as destructive, as the crown fires in the West. A considerable proportion of the forest fires in the South are intentionally set out, one of the principal reasons being to remove the dead grass and to provide easily-attainable green forage for cattle in the spring of the year. Except where fire-protective organizations are attempting to control fires (and this represents, in the aggregate, less than 30 per cent of the forest area of the South), practically nothing is being done to prevent their occurrence or to stop them once they have started. The use of fire in this southern region presents a very complicated problem, one important aspect of which involves the use of open range land by non-owners.

From the standpoint of research on fire, it has seemed best to concentrate on studies of fire damage, so that definite information may be made available as to the actual effects of fire on the practice of forestry. Most of the Station's studies are, therefore, concerned with fire damage. This information is being obtained on permanent plots of the various species of southern pines where controlled fires are set at yearly intervals under closely-observed conditions. Besides these intensive studies on seedlings and trees of varying ages, specific observations of the effect of fires have been made in connection with extensive surveys of cut-over lands throughout the South.

A summary of the available information on fires in the Coastal Plain region is in preparation as a government bulletin

In order to find out how much damage fire can cause in young second-growth longleaf stands up to pole size that have been protected from fire for a number of years, two small areas were burned over in the protected, ungrazed area at the branch Station at McNeill, Mississippi. Trees on the two plots were similar as to size and density of stocking, and the ground-cover had neither been grazed nor burned for the previous seven years. One plot was burned under very dry conditions in October 1929 whereas the other fire was set during a damp day in mid-winter, January 1930. The fall fire killed trees as large as seven inches in diameter and wiped out 64 per cent of all the trees on the plot, and seriously injured the remainder. The winter fire killed but 6 per cent of the stand, all of these being in the one and two-inch diameter classes; the remainder were apparently uninjured.

A series of tests to determine the relative value of chemicals as fire extinguishers, spraying the chemicals from back-pumps onto grass fires, was carried out in January 1930. The effectiveness of solutions of sodium acetate, potassium chloride, potassium nitrate, potassium dichromate and a proprietary compound (mixture of sodium and potassium carbonate) was compared with water. The chemicals proved to be little if any more efficient than water, while beating out fire with a pine-top gave the best results of all.

A number of soil samples from Station fire plots have been collected and these are being analyzed for chemical constituents. This should give us something definite on the effect on the soil of annual fires continued over a period of years.

The effect of annual fires since 1923 on the longleaf cone crops of 1927 and 1929 at McNeill was indicated by a definite but not particularly significant superiority in number of cones produced per tree on the area protected from fire.

One year after a winter fire had burned over part of a four-year-old slash pine plantation in southern Mississippi, the mortality showed 8 per cent higher where the fire had burned than on a similar unburned area (37.7 per cent contrasted with 29.5 per cent) and the current annual height growth the year following the fire had been cut down more than a foot (average total height 1 year after fire, 12.4 feet on unburned, contrasted with 11.2 feet on the burn).

It is planned to continue the present burning experiments and to make additional fire studies by the extensive survey method, thus adding to our present fund of information on the effects of single or repeated fires on a great number of sample areas where past fire history can be determined. Fire data from a number of Station projects will be included in the bulletin, "Fire in the Coastal Plain," which it is planned to have in shape for publication during the coming year.

Management

The manuscript by R. D. Forbes, entitled "Timber Growing and Logging and Turpentining Practices in the Southern Pine Region," is now available as United States Department of Agriculture Technical Bulletin 204, October 1930. This publication is the most important single contribution yet put out from the Southern Station, and includes the results of many of the Station's studies. In it are pointed out the steps necessary to produce new crops of pine timber for wood or naval stores, how much it is likely to cost, and what the risks are. It presents a clear picture of the forestry possibilities of the South and the essential methods whereby forest lands in this region may be kept fully productive. Copies of this Bulletin may be obtained by writing to the Station.

The Station's forest management investigations, which aim to determine the best methods of handling timber stands for growth and natural reproduction, include such studies as thinning second-growth pine stands, methods of cutting in virgin and second-growth pine, factors influencing the establishment, survival and development of pine seedlings (effect of competition, weather, soil, fire and other enemies, distance from source of seed, water relationships, etc.), factors influencing seed production (effect of fire, turpentining, grazing, rodents, age, size and other characteristics of trees, density of stand, weather, etc.), methods of eliminating undesirable or defective trees or brush from the stand, methods of slash disposal, growth of trees left on cut-over areas, etc. Most of these studies have involved the establishment of permanent sample plots on which observations or remeasurements are made at varying intervals of time; other studies have been more extensive in character. representing single examinations of areas on which the past history of the stand could be obtained (extensive survey method, used on cut-over lands in every southern state, 1925-1930).

The past year has seen the establishment of two comprehensive method of cutting studies, one in second-growth loblolly pine at Urania, in connection with a logging and milling cost study conducted by the Forest Products Laboratory, the other in virgin longleaf pine on the Choctawhatchee National Forest. The former consists of five one-acre plots in a forty-year-old loblolly pine stand, averaging 20,000 board feet per acre, on which the following cutting methods were used: (1) accretion cutting, leaving 37 well-spaced dominant trees per acre from twelve inches to sixteen inches D.B.H.; (2) clear cut, removing all trees over four inches D.B.H.; (3) diameter limit cutting, removing all trees over eleven inches D.B.H.; (4) selection cutting, leaving 61 well-spaced intermediate and codominants from seven inches to twelve inches D.B.H.; (5) check plot, uncut. Other data on these plots have been summarized in the following table:

Per Acre Basis

Method	Total Number of Pine Trees 4" D.B.H. and over			Volume in Board Feet International 1/8" rule 5" top diameter		
	Before Cutting	After Cutting	Per cent of original number of trees left	Before Cutting	After Cutting	Per Cent of Original volume remaining
1	217	37	17	18,585	6,827	37
2	173	--	0	20,217	--	0
3	224	158	70	21,829	7,646	35
4	204	61	30	24,764	5.933	24
5	216	216	100	20,177	20,177	100

The small trees cut on these plots and wood in the tops were utilized for pulpwood, producing 8-1/2 cords per acre

Data on relation of density of stand to quality of lumber produced were taken by the Section of Silvicultural Relations of the Forest Products Laboratory.

On the Choctawhatchee National Forest, six plots of ten acres each were laid out during the summer of 1930, in virgin longleaf pine averaging over 150 years old, and were marked for cutting by the following methods: (1) clear cut in alternate 66-foot strips; (2) seed-tree cutting, leaving 4 or 5 seed trees per acre; (3) seed-tree cutting, leaving 9 or 10 trees per acre; (4) clear cutting and planting; (5) uniform shelterwood (light cutting); (6) check, or uncut. The areas have been mapped, the trees on 3.6 acres in the center of each 10-acre plot described, and pine reproduction mapped on 540 milacre quadrats. This tract has a stand much better than the average for the forest; trees over 10 inches D.B.H. have been turpentined for 13 years (1914-1920 and 1923-1928), and it is planned to have the cutting done during the winter of 1930-1931. Data on these plots are given in the following table:

Method	Number of Pine Trees Per Acre 2" D.B.H. or Over			No. of seed trees 7" or over per A. left.	Volume in Board Feet of all Trees 7" D.B.H. or Over. Scribner Decimal C Rule		
	Before Cutting	After Cutting	% original No. of trees left		Before Cutting	After Cutting	% of original volume remaining.
1	103	40	39	24	3,539	1,872	53
2	61	29	47	4	2,922	322	11
3	58	28	48	9	1,647	317	19
4	54	0	0	0	3,139	0	0
5	92	65	71	47	6,042	3,172	52
6	63	63	100	45	3,625	3,625	100

A number of silvicultural improvement tests were put in on the Ouachita National Forest, Arkansas, in the fall of 1929, for the purpose of finding a successful method for killing undesirable hardwoods on cut-over shortleaf pine land. Tests were made to compare (1) girdling and (2) girdling and treating with chemicals. Two chemical mixtures were used, one a mixture of white arsenic and sodium hydroxide, the other a proprietary compound containing calcium chlorate. In addition, 10 small-scale tests were put in, using a variety of chemicals. Reexamination of the plots eight months after they were established showed that the chemicals did not prevent sprouting. Girdling alone gives satisfactory results, but will result in a large number of snags and a consequent increase in fire hazard. It was found that black, red and black jack oaks are killed back easily by girdling alone, white and post oak and hickory are killed less easily, and elm and black gum killed least easily of all. The use of arsenic compounds kills the tops more effectively than girdling alone, but stimulates sprouting.

Eradication of oak brush on the Choctawhatchee National Forest by means of spraying with poison has been tried out recently, but the results will not be definitely known for several months.

Additional management studies proposed for the coming year include the establishment of a series of method of cutting tests in virgin shortleaf pine on the Ouachita National Forest, Arkansas, and similar experiments in second-growth loblolly and shortleaf stands in the Southeast. The proportion of the total lumber cut which comes from second-growth stands has increased until now over half of the pine lumber produced in the South is second-growth. This percentage is expected to increase rapidly as the old virgin timber is cut out. It is important, therefore, to know what cutting methods will insure natural reforestation of these stands. Studies of this kind were provided for by an increase of $10,000 in the 1931 appropriation for the Southern Station. Other proposed studies under this project include extensive surveys of cut-over lands in the second-growth pine stands in the Southeast, where the bulk of the second-growth lumber cut originates. Additional thinning plots are also needed to round out the plots already established, of which there are now 41, including some in each of the four principal species of southern pine.

Forestation

The profitable use, for timber-growing, of many millions of acres of denuded and partially-stocked cut-over land throughout the South will depend to a great extent on artificial planting.

Due to fire and improper management, most cut-over pine and hardwood lands are at the present time producing but a fraction of their potential timber growth. On many cut-over tracts there remains only a cover of brush, inferior species, and defective trees. Economical methods of artificially reforesting to valuable species of trees must be devised if the bulk of the forest land in the South is to again produce a profitable forest crop. The Station's forestation studies are planned to answer the many questions concerned with forest tree seed and with nursery and planting practices for this region.

Substantial progress has been made during the past year in forwarding the forestation experimental work. Visits to several school, state and commercial nurseries have resulted in valuable addition to the information obtained from our own earlier studies. Most of our experimental plantations at Bogalusa have completed their fifth year in the field, and individual measurements of all but a few of the planted trees, taken each year for four or five years, have been computed by means of the punch-card machine, and the results await final analysis. These computations should give us definite figures on the effect of season of planting, tools used, method of pruning roots, grade of stock, soil on which the plantation is established, and attack by rabbits, insects, and diseases.

Data concerning the yields of seed from cones of various species have been compiled and published, and all the germination tests made by the Station to date have been worked up and partially analyzed. The analyses so far completed justify the dependence placed upon the Station's standardized sand flat germination tests, the technique of which has been greatly improved during the past year. The remaining study of the germination records will bring out the results of all of our seed extraction and seed storage tests up to and including 1929-1930.

The results of the forestation studies described above are intended for publication in bulletin form.

The two outstanding accomplishments of the year in forestation are the expansion of forest planting on the Choctawhatchee National Forest beyond the stage of small experiments (cooperation in establishment of two 6-acre longleaf pine plantations), and the demonstration of successful storage of longleaf pine seed for one and two years. The successful method of storage is at temperatures at or slightly above freezing, in sealed or at least nearly air-tight containers, and it is already being tried to some extent on a commercial scale, with longleaf and other southern pines.

Increasing interest in forestation has emphasized the need for a number of studies and undertakings. Among these may be mentioned further checking of seed-storage methods, further improvement of germination test technique, study of nursery fertilizers, studies of spacing in plantations, investigations of the effect on both productivity and safety of mixing species in plantations, and especially a study of the effect of geographical source of seed and character of parent tree upon the productivity of plantations. The rapid diameter growth of the southern pines is offset in part by their relatively short trunks at maturity, as compared to many northern and western species, and if this handicap can be in part overcome by selecting seed from the tallest strains or races, the fact should be ascertained as soon as possible.

Grazing Studies

Studies of the interrelation of cattle-raising and timber-growing have been under way since 1923 on a 320-acre experimental area at McNeill, Mississippi, in cooperation with the Coastal Plain Experiment Station. Cattle are being grazed (summer season, March to November) on native grass pastures at the rate of one head to 7-1/2 acres, although previously one head to 10 acres had been used for 5 years (1923-1927) and 1 head to 5 acres for 1 year (1928). Half of the area has been burned every winter since 1923 and the other half protected from fire. In addition, two check-plots of 10 acres each, one burned annually and the other protected, have been kept ungrazed. Our studies deal principally with the effect of fire and grazing on the establishment and survival of longleaf pine seedlings from the 1924 seed crop which came from the numerous seed-trees left in the logging operation 20 years previously. The number of 1924 seedlings which became established ranged from 14,000 to 18,000 per acre. In the spring of 1930, when these seedlings were beginning their sixth year's growth, the survival under the four conditions was as follows:

Unburned and ungrazed	73 per cent
Burned and Grazed	9 per cent
Burned and ungrazed	13 per cent
Unburned and grazed	27 per cent

The heavy grazing in 1928 resulted in many seedlings being killed on the grazed pasture (20 per cent loss during that year compared to 3 per cent on the ungrazed plots). Seedling losses due to grazing have been caused mainly by overgrazing. Fire seems to be a much more important factor in the development of longleaf pine seedlings than is the grazing of cattle.

The results from a forestry standpoint thus far seem to indicate that cattle-grazing does not seriously interfere with the development of longleaf pine seedlings if grazing is not too heavy and if fires are kept out.

Many additional investigations are under way on the McNeill area. The effects of fire and grazing are being studied by noting the effect on the soil as determined by chemical, mechanical, and bacteriological analyses, by tests of the physical condition of the soil as measured by a penetrometer, by fertility tests using corn phytometers, by removing competition of all vegetation from around pine seedlings on small areas and observing succession of vegetation. It is planned to study the correlation between evaporation and soil moisture as found on the unburned and ungrazed plot with similar areas from which all grass and other competition have been removed. Before arriving at any final determination of the effect of fire and grazing, it would be well to know more about the factors of light and root competition where both grazing and fire are excluded.

Forest Measurements

During the last year, two U. S. Department of Agriculture publications, based largely on field work of the Southern Station, on the growth and yield of the four principal southern pines, have appeared. These are "Volume, Yield, and Stand Tables for Second-Growth Southern Pines," Miscellaneous Publication No. 50, September, 1929, and "Rate of Growth of Second-Growth Southern Pines in Full Stands," by R. D. Forbes and Donald Bruce, Circular No. 124, October, 1930. These publications give information on how to determine the productiveness of cut-over pine lands and how much various types of trees on proper soils may be expected to yield when cared for and protected from fire. They include tables which show the number of cords of pulpwood or board feet of lumber in trees of different size and in stands of various ages and for soils of varying productiveness. These publications will serve as manuals for farmers and lumbermen, as well as for foresters, because the information that they give on forest growth is essential to any well-ordered management of land for timber production.

Although the yield tables which appear in the above publications apply primarily to even-aged stands growing at average maximum capacity, they give a picture of the possibilities of timber growing in the southern pine region. There is need for further information on how these tables for fully-stocked stands can be applied to the uneven-aged and understocked stands typical in the South. This information will be supplied by observations carried on over a period of years on a number of yield plots in understocked stands of varying densities. A few such plots have already been established by the Southern Station, two of them during the past year, in loblolly pine at Urania. Many more plots of this kind are needed to cover the vast range of growing conditions found throughout the South, and it is planned to establish a few such plots each year or as fast as the Station's available funds and personnel will permit.

Dendrometers were set up on nine longleaf and one slash pine, all virgin trees, on the Choctawhatchee National Forest, Florida, to determine when diameter growth takes place and the effects of climate on growth. Measurements have been taken at weekly intervals since March, 1930.

Naval Stores

Detailed consideration of the Station's naval stores program and its relation to the naval stores industry in the Southeast has been given in former annual reports of the Station. Naval stores investigations have been under way at the Starke, Florida branch of the Southern Station since 1923. The work there has expanded until it is now the largest single line of silvicultural investigation under way at the Station.

The major accomplishment on naval stores during the past year has been the completion of the first draft of Wyman's manuscript which has been submitted to Washington for publication under the title "Results of Experimental Turpentining of Slash and Longleaf Pines."

The second five-year series of methods of chipping tests started at Starke in 1926 will be worked out during the fall of 1930, and the depth of chipping and width of face tests in both slash and longleaf timber will be discontinued at that time. The height of chipping tests will also be discontinued except for the quarter-inch and half-inch heights, which will be carried on for two to four years longer, until the faces reach the same point that the three-quarter inch chipping attained at the end of the fifth year of work.

Of the 3925 trees which have been chipped during the 1930 working season, about 2340 will be dropped next year. Some 580 new trees will be chipped next season and these, together with the old tests which are continuing, will give us about 2140 trees to be worked during 1931. In addition, it is expected that certain other tests can be laid out in the vicinity of Lake City on the proposed experimental forest.

In the fall of 1929, the gum yield test at Kiln, Mississippi, was discontinued, as the essential information had been obtained. The Dukes tract was abandoned during the winter of 1929-30 because of severe injury caused by an uncontrolled fire. At the end of the 1930 working season, the gum yield test on virgin longleaf on the Choctawhatchee National Forest will be discontinued, as all the desired data have been obtained. Finally, the Union tract test is being closed out because the timber owners are cutting the trees at this time.

A Progress Report on the influence of commercial fertilizers on gum flow indicated that ammonium sulphate increases slightly the gum yield from fertilized trees for the first two years. Acid phosphate application also gave a definite increase in gum yield which was, however, less than that obtained from the use of ammonium sulphate. Muriate of potash and phosphate screenings, the other fertilizers that were given a trial, did not cause any increase in gum production.

A progress report covering the results of French face chipping indicated that French faces on longleaf trees produced 22 per cent more gum than American faces of the same width during the first year of work and 28 per cent more the second year. Another test in slash pine showed that two groups of French face trees yielded, respectively, 23 per cent and 25 per cent more gum than the group of trees with American faces with which they were compared. It was also shown that the yield from a standard French face of four-inch width was greater from large trees than from small ones.

During 1930, three naval stores thinning plots were established in a heavy stand of 32-year-old longleaf (900 trees per acre) which was thinned down, leaving 200 of the best trees per acre. On one plot, the thinning was done by cutting out all trees marked for removal, and on the other plot, the trees to be removed are being turpentined first. French faces were used and two, or in some cases three faces were placed on a tree, depending on size.

A new test on the effect of annual burning on gum production was established at Raiford in the spring of 1930. 58 second-growth slash pines on an unburned plot, and the same number on a plot which has been burned over annually for the past six years, were chipped during the present season. The gum yield figures for these plots are not yet available.

A study of the effect of turpentining on tree growth based on stem analyses from turpentined trees has been under investigation during the past two years. This study indicates a very wide variation in the effect of chipping on height growth, ranging from none to a 50 per cent decrease in growth rate. The method of chipping seemed to have very little effect, except that where two faces were placed on a tree the height growth was cut down considerably more than where only one face was used. The portion of the tree trunk directly above the face showed a decided decrease in growth. The part of the tree opposite the face was practically unaffected, whereas the shoulders of the face or the bark-bar between two faces often showed an acceleration in growth rate.

No further field work has been done on the study of the relation between environment and gum yield but the results of the chipping done in 1926, 1927, and 1928 are being worked up at this time. It is expected that a report on this test will be completed during the coming winter.

The attempt made at Starke to obtain by hand pollination cones from high yielding strains of trees and a hybrid cross between slash and longleaf parents failed, as none of the cones developed. A very heavy loss in normal cone development indicates that technique may not have been the main cause of the failure of our test. (At Bogalusa, six cones developed from longleaf flowers pollinated with slash pine pollen, and seed is now being extracted from these cones.).

Extensive surveys in Georgia and Florida included studies of fire damage, hog damage, and the effect of hardpan on root development. Where hog damage was severe, from five to seven per cent of the longleaf saplings under three inches in diameter had been killed during the past few months, and from 46 to 85 per cent of all saplings showed considerable hog injury.

The new work planned for the 1931 chipping season will include a study of interval of chipping, comparing weekly chipping with daily, twice and three times per week chipping. About 120 longleaf trees will be used in this study. An advance streak test will be tried on 400 longleaf trees and will comprise a check group, a group chipped three weeks before the regular turpentine season, another chipped six weeks ahead and a third group chipped nine weeks ahead.

The new project covering the relation between fire and gum production will be expanded during 1931. The effect of fire on tree growth as reflected in the soil fertility will be investigated through the use of phytometers, taking soil from burned and unburned localities. The effect of defoliation and the effect of fire on root development will also be studied. Additional tests to show comparative gum yields from burned and unburned land will be begun if suitable areas for the tests can be found.

Cooperation with Miss Gerry and Dr. Hall of the Forest Products Laboratory is contemplated in connection with the fire and gum production project. The Laboratory plans to investigate the effect of fire on gum characteristics and tree structure.

Erosion Studies

Studies of the influence of forests on soil erosion were initiated in the fall of 1929 by the Southern Station. The preliminary work consisted of an extensive survey of the western portion of Mississippi, which is known to be one of the most seriously eroded sections of the entire country. The erosion conditions in six separate counties (Adams, Carroll, Jefferson, Lafayette, Marshall, and Wilkinson) in Mississippi were studied in detail and general observations were made in ten or twelve other counties, all of which occur in the silt loam upland region of the State. This soil region covers an area of approximately 9,000,000 acres, or more than a quarter of the entire area of the State of Mississippi.

This preliminary reconnaissance was made with the idea of obtaining a better basis for the attack on the erosion problem, to find out where the most serious erosion has been taking place, what has caused it to start, and how it is progressing, as well as to ascertain what control steps have been taken and their effectiveness. It was desired particularly to find out what effect forest cover has in preventing erosion or in helping to control gullies once they have started.

The studies thus far have shown that among the factors hastening the rate of erosion of good top soil and which are ruining thousands of acres of good land in Mississippi are the following: Overgrazing, repeated grass and brush fires, use of improper methods of cultivation, absentee ownership, one-crop farming, present system of taxation on standing timber, and improper road drainage.

When soil wash first manifests itself, it takes the form of sheet erosion, through which the whole surface loses a portion of its fertile top soil. If nothing is done to control sheet erosion, it soon develops into the second stage, or shoe-string gully type. The gullies start as small washes down the slope and at first are only a few inches deep. At this stage, remedial measures such as the building of terraces, sodding the slopes to Bermuda grass, or the building of small brush dams can be easily applied. If no measures are taken to stop the waste, it is not long before gullies merge; the increased volume of water has increased eroding power and deep ravines and chasms may be formed. In Jefferson County, Mississippi, an area with a 15 per cent slope was cleared and planted to cotton in 1910. By 1920, it had to be thrown out of cultivation due to erosion and the formation of gullies. By 1930, some of the gullies were 10 to 12 feet deep and 15 per cent of the surface area of this once-fertile field had been cut up and washed away.

In Lafayette County, Mississippi, a ravine 20 to 30 feet deep has been eating its way back into a fertile field for the past seven years at a rate of about 30 feet per year. The silt loam forming the top soil in this field has been washed away and with it have gone thousands of tons of sand and clay. Two million tons of soil have been washed out of one large ravine in Marshall County, Mississippi, where erosion has cut a gash 2,000 feet long, 300 to 400 feet wide and 100 feet deep, in a gently-sloping hillside. The drainage from an old road caused this ravine to start, and nothing is being done to stop its advance. Other examples could be cited. Our studies show that over 30 per cent of the land areas of three counties in north Mississippi has been ruined by erosion.

Where erosion is most active, land abandonment is a very serious problem. The preliminary returns of the 1930 census indicate a decrease in the population in the three most seriously eroded counties in Mississippi during the past 10 years. This means that land values have decreased, farms have been abandoned, and the taxable values reduced.

Although the soil erosion problem in Mississippi is extremely serious, very little is being done about it. No systematic control work has been attempted and the condition of eroding areas is rapidly becoming worse. Control measures have been investigated in Tennessee where similar conditions exist, and the results of these experiments have shown that it is possible to control excessive soil losses by building brush dams and by planting black locust and honeysuckle on areas where serious erosion has already taken place.

It is planned to make more intensive studies of the amount and rate of erosion on a few typical areas in the region of most serious erosion in Mississippi. This will give more definite information on the amount of soil that has been carried away and the rate of erosion. Following this, studies of run-off and silt determinations will be made by means of small sample plots laid out in typical areas for various slopes and various types of cover. It is particularly desired to know the rate of run-off from the following types of land; forest, pasture, cultivated, and fallow. Various methods of erosion control will be tried out on lands leased or deeded to the Station for this purpose. At the present time, intensive erosion plots are being established near Holly Springs, Mississippi, in cooperation with the Mississippi Agricultural Experiment Station.

Financial Aspects of Forestry

This economic study which began last year will provide information as to the trends of timber values, costs of timber growing, returns from forestry, and other controlling factors which will serve as a sound basis for the practice of forestry under the specific conditions found in the southern United States.

One of the initial phases of the project has been the conduct of studies of selected sample counties to determine the timber-growing possibilities on small forest properties such as are found in timberlands owned by farmers and other owners of small areas, which in the aggregate make up a very large proportion of southern pine lands. A number of such county studies have been made and others are contemplated. The typical counties which have been investigated and for which reports have been completed or are now in process of preparation are the following: Alcorn County, Mississippi, typical of the shortleaf pine timber type which is being cut out rapidly by small mills; Appling County, Georgia, typical of small naval stores operations in the longleaf and slash pine region of southeastern Georgia; Lee County, Alabama, typical of the small lumbering operations in the mixed pine region in east central Alabama; Hempstead County, Arkansas, typical of the shortleaf-loblolly pine district in southwestern Arkansas; Beaufort County, North Carolina, in loblolly territory, with moderately large mills; and five counties in Florida, Washington and Bay Counties in west Florida, Hamilton County in north Florida, Bradford County in northeast Florida, and Osceola County in the southern part of the State. Each of these Florida counties is typical of the longleaf or longleaf-slash regions which are being worked extensively for naval stores products, although pulpwood, ties, poles, staves, and lumber also come into the picture.

The Financial Aspects studies include:

(a) A determination of stumpage "realization values" (residual stumpage plus profit, after manufacturing costs, including interest on capital, are deducted from sale values) and "appraised stumpage values," which are realization values less 12 to 15 per cent allowance for profit and risk margin.

(b) The above figures, coupled with actual growth, give the net stumpage income per acre from pine lands stocked with different species of southern pines in average and optimum condition.

(c) Study of taxes and other costs, together with land values to determine under what conditions the net stumpage incomes in (b) are now or promise to be a satisfactory return on the investment.

Conditions found in some of the county studies where emphasis was placed on the farm and smaller timber land holdings are, briefly, as follows:

Beaufert County, North Carolina - An example of present under-utilization. Species - Loblolly Pine, utilized for general lumber by small portable and medium large mills (50 to 75 M ft. cut per day). The present annual cut averages 208 board feet per acre for the county, with a gross value f.o.b. county of $4.43 in forest products. Annual growth is placed at 347 board feet, valued at $1.75 per acre (appraised value). Hence the county is increasing its growing stock. The 1929 "realization value" (stumpage plus margin for profit and risk; interest is deducted as a cost) was about $6.25 per M, International log scale (1/4" kerf); appraised value $5.05; and mean market value $4.32. The average stand for the county runs 3,675 board feet per acre. The increment shows a potential income of 4.6 per cent on a capitalization of $10 per acre for land and growing stock below 9 inches, and 3,675 feet in trees 10 inches D.B.H. and up. Expenses are: taxes, $0.37, protection and administration, $0.07. Taxes take, therefore, 26 per cent of the net increment before taxes are deducted.

Average well-stocked stands show an increment of 400 board feet per acre when selectively cut, which is equivalent to a return of 4.8 per cent on $10 land and young stock, and 4,500 feet of growing stock 10 inches and over at $5.05 appraised value; annual expenses are: $0.46 per acre, of which $0.39 is tax. Net returns are $1.56 per acre after deducting tax and protection and administration expenses.

The best sites showed an annual increment of 633 board feet per acre, with a mean growing stock of 6,665 board feet 10 inches and over and a $15 land value with a good assortment of smaller sizes. Net return was $2.68 per acre, or 5.5 per cent after deducting taxes of $0.45 and protection and administration of $0.07 (figured on appraised value).

The good showing of this county is due to the fact that second-growth is just coming into merchantability. As cutting increases, fire protection must improve to secure more seedlings if these selectively-cut stands are to be stabilized.

Lee County, Alabama - An example of over-utilization.

Species - Loblolly and shortleaf Pine. Land consists largely of small woodland, farmer-owned. The average annual increment for the county is 135 board feet per acre. The cut by "roofer" organizations, portable mill and central planer in 1929 was 338 board feet per acre, showing a heavy over-cut. The cut totaled $7.77 gross per acre of county forest but is falling rapidly due to the exhaustion of the growing stock. The effect of excessive fire is shown by the relatively low increment. Realization value for roofer stumpage was $6.38 (International Rule 1/4" Kerf); appraised value $4.70; and average sale value is $3.69 or $3.97 mill run (International 1/4" Kerf Rule was under-cut 7 per cent on mill test).

Including the uncut areas and young unmerchantable areas there is an average increment of 135 board feet worth about $0.64 per acre, with land and growing stock put at $12.00 (appraised value). Taxes are $0.15 or about 24 per cent of the gross increment value. Assuming an annual cut, the income after deducting taxes is about 4 per cent.

Nine uncut stands studied in this county showed a current annual growth (10-year period) or 496 board feet per acre, worth $2.33 (if cut annually), or about 5 per cent after deducting taxes (21 mills on 60 per cent of $35.88 appraised value). Protection and administration costs were omitted on these farm lands.

Appling County, Georgia

Species - Second-Growth Slash and Longleaf Pines. Principal utilization is for naval stores production; a small amount of lumber, staves, etc. are cut. The gross income in 1929 was $4.90 and net income $1.12 from all forest land. The net income from all pine land is $1.03 per acre, of which $0.78 is from naval stores. Taxes are $0.16 per acre, or 16 per cent of net (protection is an operating cost). The 1929 realization value per cup for naval stores was 3.79 cents; market value was 3.75 cents. For 1921-29 average prices the realization value for the average 35-unit crop was 7.65 cents per cup, with an appraised value (12-cent profit allowed) of 5.35 per cup.

The cut and net growth of pine balance at 9 million feet.

This is an annual growth of 54 board feet per acre, low because of poor stocking (.22 normal); an annual mortality of 2.5 per cent with a butt cull of 30 per cent for the small timber. In the next 12 years, it is estimated that the naval stores production will decrease 50 per cent for lack of sufficient young round timber, so that for this industry the income will decrease for about 12 years and then begin to increase again.

Optimum stands show a possible stabilization of naval stores stands at 100 cups per acre, or an annual naval stores income of $5.35 (appraised values on 1921-29 prices) per acre. Residual timber values should bring this up to $6.00. At 1929 prices for cup rentals, this figure would be $3.75, with residual timber bringing it up to $4.40 or better.

Present forest land and growing stock partly depleted by cupping sells for $6.00 to $15.00 per acre. There is thus seen to be a large margin of income to care for the increased costs which accompany the best forest management.

Washington County, Florida showed a less satisfactory present forest stand and income from naval stores timber, with higher taxes ($0.25 per acre). Tax studies in Florida show taxes of from $0.09 to $0.55 per acre in different counties. A remedy is now being sought for this situation.

Taxes in Georgia and Alabama on second-growth pine land generally appear more reasonable than in Florida.

Alcorn County, Mississippi, like Lee County, Alabama, showed a rapid decrease in the amount of growing stock on its shortleaf pine stands and low average increment, but the income from well-stocked and protected stands was satisfactory.

Hempstead County, Arkansas, with mixed loblolly and shortleaf forest, showed a balanced growth and cutting was taking place at the rate of about 300 board feet per acre annually.

In general, except for some of the Florida counties and others that may have excessive taxation, studies thus far indicate that the southern pine lands that are failing to earn a fair return on their cost value are always very deficient in a stand of growing trees, generally caused by fire and earlier logging methods. Getting a proper stand of trees is the keynote to financial success in growing southern pines. Present prices (not 1930 depression prices) permit a fair return already. A study of price trends is indicating better second-growth pine values for the future.

Other counties in typical forest regions in the South will be investigated during the coming year. It is anticipated that a number of these county reports will be published by cooperative agencies. Much assistance has already been obtained from state officials and private land owners in each of the counties studied.

Another important phase of the Financial Aspects Study will be the case studies of large lumber companies to determine the possibilities of timber-growing by large commercial operations in the South. This work has not yet gotten under way, but will be begun during the fiscal year 1931.

Pathology

Investigations of the diseases of forest trees and of forest products are being handled by two pathologists and their assistants, assigned to the Southern Station from the Bureau of Plant Industry.

The principal work on the pathology of forest products in the Gulf States and Lower Mississippi Valley has been directed towards devising efficient methods for controlling sap stains and molds in domestic and export lumber and logs. Experiments have been limited to the use of antiseptic solutions, applied to lumber as dips or sprays, because it was evident from a preliminary survey that such chemical control offered the best possibilities of giving immediate results of practical value. During the summers of 1929 and 1930, eight small-scale tests were established at mills located in Mississippi, Louisiana and Alabama to determine the relative effectiveness of 68 promising chemicals on both pine and hardwoods. Five of the treatments proved of sufficient effectiveness to warrant commercial trial and accordingly were used in large-scale dipping tests at five representative mills in Louisiana, Mississippi, Alabama and Florida. Mill-run of stock was employed in these tests and the methods of treatment followed those used in current commercial practices. Although a detailed analysis of the final records has not been completed, it is evident that efficient control of stain in both pine and hardwoods was accomplished by several of the treatments. These treatments satisfy the other requirements of an efficient stain preventive in that they are cheap, cause no discoloration, are easily prepared and handled, and are non-injurious to workmen or to equipment. Efficient stain prevention opens up a wide field of usefulness to the lumber industry through insuring effective control on pine at both large and small operations, and in replacing the more costly methods of steaming and end-racking of sap gum, yellow poplar and magnolia.

The need for more practical methods of preventing deterioration in stored hardwood logs resulted in the initiation of chemical control tests during the summer of 1930 at four hardwood operations located in Mississippi and Louisiana. Thirty different chemicals and combinations of chemicals which gave promise of effectively controlling either fungi or insects, or both, were applied as entire log sprays or as end coatings to logs and bolts of several hardwood species. The results of preliminary observations only are available at this time, but these indicate that several of the treatments will prevent attack by stain and decay fungi and will reduce insect injury as well.

In the laboratory, investigations of the following problems have been started (1) the staining capacity of 15 organisms isolated repeatedly from stained wood; (2) the relative rate of spread of stain radially, tangentially, and longitudinally through wood; (3) the relative water-absorbing capacity and rate of water loss of stained and unstained wood; (4) the relative durability of steamed and unsteamed sap gum.

Further work will be done on the control of the deteriorating agents which attack domestic and export lumber and logs. Recommendations of efficient treatments will be made as justified by the results. Laboratory investigations already started will be continued and extended.

The needle disease of longleaf pine seedlings caused by Septoria scicola continues to be the principal forest tree disease under investigation. Minor studies have been begun on basal decay in southern pines, and the rotting of slash. The planting of exotic chestnut seeds and seedlings in the Gulf States is being supervised.

A large part of the work with the longleaf needle disease, commonly called the "brown-spot," has been done in the field on areas of natural reproduction. The following specific tests are being made, mostly located on cut-over longleaf pine lands near Bogalusa, Louisiana.

1. To determine the effect of the disease by spraying slow-growing seedlings and comparing their development with that of adjacent unsprayed stock. Two annual measurements of the same seedlings gave the following results:

Average Height in Inches.

	1929	1930
Sprayed	1.04	1.40
Unsprayed	1.10	1.37

Similarly, height measurements are now being made on adjacent areas treated with lime-sulphur and with colloidal sulphur.

2. To obtain a substance which would control the disease without involving chemical injury or stimulation, plots have been treated with four fungicides: Bordeaux mixture, lime-sulphur, colloidal sulphur and a mixture of zinc-sulphate and lime.

3. To determine the minimum number of applications necessary to control the disease by varying the period of spraying. Practical control of the brown spot seems to be effected by spraying once a month.

4. To determine the influence of sedge and grass on needle infection and on plant dwarfing through root competition. Removal of sedge, grass and brush results in an increase in needle disease. Average dead leaf tissue on 1929 needles in plots where soil cover had been removed was 43 per cent, while on adjacent control areas the amount of dead leaf tissue was 23 per cent. It is believed that this is due to a difference in behavior of the leaf stomata, following removal of the ground cover.

5. To correlate the effect of seedling density with growth and with brown-spot disease. Milacre plots averaging 150 seedlings each were thinned to 4, 8, 16, 32 and 64 plants, respectively.

6. To determine whether solutions of "casein spreader" added to three or four fungicides, as an adhesive, could influence brown-spot infection itself. Casein spreader, in water solution at the rate of 2/3 of an ounce per gallon or slightly more than two pounds in 50 gallons. gave good control. Although it did not prevent some leaf spotting, the plots appear almost as green as some of areas sprayed with well-known fungicides.

7. To determine the effect of brown-spot on the development of forest plantations, several hundred seedlings were sprayed once or twice a month, starting in April 1929.

8. To determine the influence of fire as a measure of disease control. Preliminary studies indicate that early spring or winter burning reduces infection during the following season, but that the influence of a single fire is not carried over through a second summer.

Approximately 4,200 Asiatic chestnut seedlings were set out on the Alabama National Forest early in 1930. In addition, nursery plantings were made in two Louisiana forest nurseries.

ARTICLES PUBLISHED OR SUBMITTED FOR PUBLICATION
October 16, 1929 - October 15, 1930

Bennett, F. W. - "The relationship of scrub oak to longleaf pine reproduction in northwest Florida." Submitted to Ecology, July, 1930.

Demmon E. L. - "Relation of forest research to the naval stores industry." Journal of Forestry, 28 (4):515-520, April, 1930.

"The possibilities of producing new timber crops in the South." Proceedings of Twelfth Southern Forestry Congress, Memphis, Tennessee, April 10, 1930.

"Extending forest studies in the South." United States Daily, August 1, 1930.

Gemmer, E. W. - "A method of recording maximum and minimum temperatures of forest soils." Science, 70 (1821): 505-506. 1929.

"A word for exotics." Submitted to Journal of Forestry, October 1930.

"American ingenuity and reforestation." Submitted to Journal of Forestry, October 1930.

Harper, V. L. - "Mortality of second-growth pine in the South caused by turpentining." Submitted for 1931 Department of Agriculture Yearbook.

"Influence of commercial fertilizers on the gum yield and growth of slash pine." Submitted to Washington.

Lentz, G. H. - "Spanish moss, a by-product of the forests." Nature Magazine, 15 (3):173-175. 1930.

"Drainage and streamflow." Journal of Forestry, 28, (5):769. 1930.

"Some hardwood growth possibilities in lower Mississippi Valley." Published in Cross Tie Bulletin, July 1930, pages 2 and 4-6; also Proceedings of Twelfth Annual Convention of National Association of Railroad Tie Producers, 1930, pages 20-23, inclusive.

Lentz, G. H. (cont.) - "Report of Second Southwest Soil and Water Conservation Congress at Stillwater, Okla." Journal of Forestry, 28 (7): 890-891. 1930.

"Cross tie operations on the Harriman Estate, 1919-1921." Submitted to Cross Tie Bulletin, September, 1930.

"From forest to farm to waste land in twenty years; an erosion cycle in Mississippi." Submitted to American Forests and Forest Life, September, 1930.

"Erosion eating up fertile lands and clogging streams of northeast Mississippi." Commercial Appeal (Memphis), October 12, 1930, page 10.

"Soil erosion in western Mississippi." Proceedings Second Soil and Water Conservation Conference, Stillwater, Okla. 1930.

Lentz, G. H.
Sinclair, J. D.
Meginnis, H. G. - "Soil erosion in the silt loam uplands of Mississippi." Presented by Mr. Lentz at the Gulf States Section meeting of the Society of American Foresters. March 14, 1930. Submitted to Journal of Forestry.

Lindgren, R. M. - "The deterioration of logs in storage and its prevention." Southern Lumberman, March 15, 1930, page 49. Lumber Trade Journal, March 15, 1930, page 20.

"Control of sap stain and mold in southern pine and sap gum; preliminary experiments on control by chemical treatment." Southern Lumberman, May 15, 1930, pages 62 and 64.

Meginnis, H. G. - "Livestock poisoning as a result of eating the leaves of laurel cherry." Submitted to Forest Worker, February, 1930.

"Agriculture and forestry in the Mississippi Uplands and their relation to erosion and flood control." Submitted for the 1931 Department of Agriculture Yearbook.

Pessin, L. J. - "An Improved Soil Sampler." Submitted to Science, July, 1930.

"Timber growing combined with cattle raising on cut-over lands in the South." U. S. Department of Agriculture Yearbook, pages 512-514. 1930.

Righter, F. I.
Barrett, L. I. - "Working plan for experimental thinnings in shortleaf and loblolly pines." Journal of Forestry, 27 (7): 782-803. 1929.

Rudolf, P. O. - "A comparison of several of the growth per cent methods of predicting growth." Journal of Forestry, 28 (1): 28-33. 1930.

"Some phases of forest management in the Southern turpentine region." Gopher Peavy, University of Minnesota Annual, pages 68-70, 1930.

Sinclair, J. D. - "Early observations of soil wastage in Mississippi." Submitted to Forest Worker, October, 1930.

"Man made waste land in Mississippi." Submitted to Southern Agriculturalist, October, 1930.

Wakeley, P. C. - "Preliminary observations on the pine tip moth (*Rhyacionia frustrana* Comst.) on Southern pines. Proceedings Fourth International Congress on Entomology, 1928. 2:865-868. 1929.

"A foolproof method of planting longleaf pine seedlings." Forest Worker, November, 1929, page 7.

"Average seed yields for Southern pines." Forest Worker, March, 1930, pages 10-11.

"Seed yield data for Southern pines." Journal of Forestry, 28 (3): 391-394. 1930.

"Panaceas, specifics, and the forestry situation." Journal of Forestry, 26 (4): 447-452. 1930.

"Fitting forest planting to American needs." Journal of Forestry, 28 (4): 500-503. 1930.

"Forestation with graded planting stock in the South." Submitted for the 1931 Department of Agriculture Yearbook.

Wyman, L. - "Higher returns from turpentine forests." Weekly Naval Stores Review, 40 (12): 15-16. 1930.

"Results of experimental turpentining of slash and longleaf pines." Submitted to Washington for Departmental Bulletin, June, 1930.

Ziegler, E. A. - "The advantages of growing pine timber on the farm in the South." Submitted for 1931 Department of Agriculture Yearbook.

"Growing trees for conversion into synthetic lumber." Paper presented at Southern Logging Association, October 25, 1929. Lumber Trade Journal, November 1, 1929.

Ziegler, E. A., and Spillers, A. R. - "Report on a financial study of growing slash and longleaf pines in Appling County, Georgia. Submitted to Washington for multigraphing, October, 1930.

Radio Addresses over Station WWL, Loyola University, New Orleans

Demmon, E. L. - The Southern Forest Experiment Station. February 6, 1930.

Lentz, G. H. - Soil erosion as related to the Mississippi River flood problem. September 20, 1930.

Lindgren, R. M.-The deterioration of wood and its prevention. June 7, 1930.

Pessin, L. J. - The structure and life of the forest tree. July 12, 1930.

Wakeley, P. C. -Silviculture and forest planting. May 24, 1930.

Ziegler, E. A.- The cost and returns of pine timber growing in the South. October 11, 1930.

Radio Address over WRUF, University of Florida, Gainesville

Wyman, L. - The work of the Southern Forest Experiment Station at Starke, Florida. April 7, 1930.

3,27.

DEPARTMENT
LIBRARY

R - SS
Investigative Program

April 2, 1932

ELEVENTH ANNUAL REPORT

of

SOUTHERN FOREST EXPERIMENT STATION

October 16, 1930 - December 31, 1931

STAFF
SOUTHERN FOREST EXPERIMENT STATION
October 16, 1930 - December 31, 1931.

E. L. Demmon	Director
E. A. Zeigler (Resigned September 30, 1931)	Senior Forest Economist
W. E. Bond	Forest Economist
G. H. Lentz	Silviculturist
W. G. Wahlenberg	Associate Silviculturist
P. C. Wakeley	Associate Silviculturist
Lenthall Wyman	Associate Silviculturist
L. J. Pessin	Associate Forest Ecologist
*P. V. Siggers	Associate Pathologist
J. D. Sinclair (Transferred to California Forest Experiment Station, Oct. 11, 1931)	Assistant Forest Ecologist
J. L. Averell (Resigned August 12, 1931)	Assistant Silviculturist
Henry Bull	Assistant Silviculturist
R. B. Craig	Assistant Forest Economist
E. W. Gemmer	Assistant Silviculturist
V. L. Harper	Assistant Silviculturist
M. M. Lehrbas	Assistant Forest Economist
R. K. Winters	Assistant Silviculturist
*R. M. Lindgren (Furloughed September 13,1931)	Assistant Pathologist
F. K. Beyer	Junior Forester
C. A. Bickford	Junior Forester
R. A. Chapman	Junior Forester
J. W. Cruikshank	Junior Forester
V. B. Davis	Junior Forester
E. B. Faulks	Junior Forester
E. A. Foster	Junior Forester
F. D. Heyward	Junior Forester
T. A. Liefeld	Junior Forester
H. G. Meginnis	Junior Forester
J. C. Osborne	Junior Forester
C. F. Olsen	Junior Forester
J. A. Putnam	Junior Forester
R. R. Reynolds	Junior Forester
P. O. Rudolf (Transferred to Lake States Forest Experiment Station, Dec. 1, 1930)	Junior Forester
A. R. Spillers	Junior Forester
P. R. Wheeler	Junior Forester
T. E. Pease	Senior Forest Ranger
T. N. Busch (Transferred to Osceola National Forest July 1, 1931)	Assistant Forest Ranger
R. M. Barnette (Florida Agricultural Experiment Station)	Agent

J. A. Lubbe	Junior Administrative Assistant
Vera S. Lind	Senior Clerk
Effie C. Herndon	Clerk-Stenographer
Bettie C. Busch	Clerk (Statistical)
Mary C. Regan	Assistant Clerk (Statistical)
Lucille P. Olsen	Junior Clerk (Statistical)
Jessie Evans (Temporary)	Junior Clerk
Camelia M. Larson	Assistant Clerk -Stenographer
Agnes G. Terburg (In Cooperation with District Forest Inspector)	Assistant Clerk-Stenographer
Elizabeth Bergland	Junior Clerk-Stenographer
Marie M. Fled	Junior Clerk-Stenographer
Mary S. Gleger	Junior Clerk-Stenographer
Ruth Marshall	Junior Clerk-Stenographer
Pearle H. Morris (Transferred to U. S. Engineers, June 8, 1931)	Junior Clerk-Stenographer
May M. Patchett	Junior Clerk-Stenographer
Lillian M. Redon (Temporary)	Junior Clerk-Stenographer
Leo W. Cooper	Junior Messenger

Temporary Field Assistants

F. W. Bennett
*A. D. Chapman
T. S. Coile
*A. W. Davidson
J. D. Diller
T. C. Evans
O. W. Genth
*L. D. Glenn
*Harold Hay
Morris A. Huberman
*Frank Kaufert
*F. G. Liming
T. E. Maki
*L. O. Overholts
J. A. Putnam
*Theodore C. Scheffer
Allen G. Watkins

* - Office of Forest Pathology, Bureau of Plant Industry, cooperating with the Southern Forest Experiment Station.

pathology investigations into the field of the southern hardwoods. The progress of investigations under way at the Southern Station during 1931 will be briefly discussed in this report, together with proposed plans for 1932.

The Station continues to obtain the closest cooperation from a great number of Federal, State and private agencies throughout the Southern territory.

Advisory Council

The seventh meeting of the Southern Forest Research Advisory Council was held November 7-8, 1930, and the eighth meeting on December 30, 1931. The 1930 meeting was held in the field, the Council being the guests of Chairman Henry E. Hardtner at Urania, Louisiana. This was the most successful field meeting of the Council to date, and the attendance, including visitors, was over 100. These included lumbermen, timberland owners, foresters, and naval stores operators from every part of the South. The 1931 meeting was held at New Orleans in connection with the annual meeting of the Society of American Foresters. The Station's program and plans were discussed in detail at both meetings and were approved by the Council.

Personnel

The increase in Station funds has resulted in an expansion of the Station staff, although not to the extent originally contemplated, due to the curtailments later imposed. A number of resignations and transfers were partially taken care of by replacements, although there remain a few vacancies. The present staff numbers thirty-one technically trained men, a clerical force of fourteen and a varying number of temporary field assistants.

During the last year the Station has lost through resignation Senior Forest Economist E. A. Zeigler, who left to become Director of the Pennsylvania Forest Research Institute at Mont Alto, Pennsylvania; and Assistant Silviculturist J. L. Averell, who is working towards a Doctorate's degree at the University of California. Assistant Forest Ecologist J. D. Sinclair was transferred to the California Forest Experiment Station, Junior Forester P. O. Rudolf to the Lake States Forest Experiment Station and Forest Ranger T. N. Busch to the Osceola National Forest. Assistant Pathologist R. M. Lindgren is at present on leave of absence taking advanced work at the University of Wisconsin. Staff men detailed to the Office of Forest Measurements, Branch of Research, in Washington during the year were Assistant Silviculturist V. L. Harper, from December 19, 1930, to September 8, 1931, and Junior Forester R. A. Chapman, beginning October 1, 1931.

Among the new appointees were Junior Foresters Beyer, Davis, Faulks, Foster, Putnam and Wheeler, and Assistant Forest Economist Lehrbas assigned to the Forest Survey; Junior Foresters Bickford, Liefeld and Osborne and Ranger Pease to Management Studies; and Assistant Forest Economist Craig to the New Public Domain project.

Centers of Work

The station has, at present, six branch stations where most of its field investigative work is centered: Urania and Bogalusa, Louisiana; McNeill, Mississippi; and Camp Pinchot, Starke and Lake City, Florida. New office quarters were made available at Bogalusa, Louisiana, April 1, 1931, upon the completion of the new Federal building there.

The need for experimental forests is recognized (1) to obtain permanency for field plots, (2) to assure adequate protection and (3) for demonstration purposes.

A branch on the Ouachita National Forest in Arkansas has been under consideration for some time and preliminary surveys were made during the last year to locate a suitable experimental forest area. The extreme irregularity of the stands made it difficult to find an area that, by itself, could be considered typical of the shortleaf pine forest in that region. For this reason, no recommendations have yet been made, but a definite selection may be possible during the coming year.

The need for the setting aside of Natural Areas is also recognized and a tract of virgin longleaf pine on the Choctawhatchee National Forest in western Florida has been tentatively selected in agreement with the Regional administrative organization.

An event of outstanding importance to the Station during the last year was the acquisition and setting aside of the Olustee Experimental Forest near Lake City, Florida. Here it is planned to center most of the Station's future experiments relating to the management of turpentine forests. The Olustee Experimental Forest adjoins the Osceola National Forest and borders the state highway, being located about ten miles east of Lake City and fifty miles west of Jacksonville. The present experimental area includes approximately six hundred acres of young second-growth timber, mostly longleaf pine, and much of it of turpentining size, none of it having been worked. It is planned to round out this area, by further acquisition, so that ultimately we will have a well blocked out unit of approximately two thousand five hundred acres. The development of the Olustee experimental tract was begun in June 1931, when several Station men were transferred to Lake City from Starke, Florida. The six hundred acres were carefully cruised and a type map made. Permanent corners were established and the area subdivided into ten-acre compartments for greater convenience in managing the forest intensively. It is planned to enclose the entire experimental forest by a hog-proof fence. A good fire line has been constructed around the boundaries. To make the forest readily accessible a few additional roads and bridges will be needed. This work, together with the erection of a headquarters building, including a Ranger's residence, work shops, laboratories, and storage sheds is now being planned. The experimental forest headquarters will be located in the new Federal building at present under construction in Lake City, Fla.

Ten acres on the Olustee Experimental Forest have been set aside for the Bureau of Chemistry and Soils, where experimental stills and a gum research laboratory are being set up. The work of the Bureau of Chemistry and Soils in the handling and distillation of gum will tie in closely with the Station's work on improved methods of turpentining.

Plans for the initiation of forest management projects on the experimental forest are being formulated gradually. In developing future investigative plans for the experimental forest careful consideration will be given the needs of the local National Forest administrative organization in obtaining the basic data that will help them to solve their forest management problems.

Current Investigations

Fire

The relation of fires to forest growth in the South is complicated by the fact that, although some fires cause a great amount of harm, others may result in no apparent damage or may even be beneficial. There is no question as to the harmful effects of fire under certain conditions. Neithe is there any doubt that light winter fires under certain conditions have little or no apparent effect on certain kinds of forest growth. However, not all tree species react the same to fire; some are much more fire-resistant than others. Obviously, it is impossible to make a general statement on forest fires that is applicable to the southern pine region as a whole.

The question of fire touches many of the Station's studies. It enters into a number of the management projects, particularly those where controlled fires are used as a silvicultural agent. A study of the relation of fire and grazing to the establishment and survival of longleaf pine seedlings is another example. The relation of fire to naval stores yields, to erosion, to plant succession, to cone production, and to the survival and growth of forest tree seedlings, are being investigated in various parts of the South.

Most of the Station's fire studies have to do with the effect of controlled annual or periodic fires on second-growth pine stands. Information is being obtained on a number of permanent plots of the four principal species of southern pines. In addition to these specific studies, many observations on the effects of fire have been made in connection with extensive surveys of cut-over pine lands in various sections of the South. Comparisons have been made between areas which have been protected from fire for a number of years with areas that have been subject to annual or periodic burning or single fires following a number of years of protection.

All of the Station's available information on fire has been gathered together in a manuscript entitled "Forest Fires in the Southern Coastal Plain", the first draft of which is nearly completed. It is recognized that present information on forest fires in the South is far from adequate for any comprehensive publication on the subject.

A few important points relative to forest fires may be set down as follows:

1. Protection from fire should be concentrated on areas which have favorable possibilities for profitable forestry practice.

2. Because of its unusual habit of growth and its high resistance to fire, longleaf pine differs greatly from all other southern pines.

3. Absolute control of fire is essential to any forestry project in the South.

4. The details of fire protection or of the possible use of fire for management purposes will vary for different tracts, so that no one set of recommendations can fit all conditions.

5. The use of fire in the silviculture and management of southern pine forests is not a simple procedure. Additional research, observation, and experience will be necessary before definite rules can be formulated, or recommendations made.

Much additional forest fire research work is needed to determine the facts for representative conditions throughout the South. Not only is it important to be able to estimate accurately the character and amount of damage caused by different kinds of forest fires, but also it is essential to be able to predict the possible beneficial use of controlled fire and the extent to and conditions under which controlled fires can be used in the management of forest stands. The funds available for fire research are entirely inadequate to cover the wide variety of conditions and the great complexity of factors involved in a region as extensive as the Station's territory.

Management

The forest management investigations include a number of lines of work designed to aid in determining the best methods of handling timber stands for maximum growth and for continuous production of forest crops. They include studies of thinning, cutting methods, natural reproduction, seed production, stand betterment, etc. These studies are carried on by means of a considerable number of permanent sample plots at the various branch stations and much of the time of the staff is taken up with annual or periodic reexamination of these plots.

During the last several years some time has been devoted each year to extensive surveys of southern pine cut-over lands. These extensive studies have served to familiarize the staff with the region and with many of its forest problems. During the last year surveys were conducted in

Texas, Louisiana, Mississippi and Alabama, particularly to study the factors limiting longleaf pine reproduction on cut-over lands, and in Florida, Georgia, and South Carolina to study naval stores problems.

A number of new thinning plots were established in 1931, including three plots (two thinned, one check) in a 45-year-old loblolly stand in northern Louisiana, seven plots (six thinned, one check) in second-growth longleaf in southern Georgia, five plots on second-growth longleaf and three plots in second-growth slash pine in northern Florida. This gives us a total of twenty-two series and fifty-nine plots (of which seventeen are check plots), with each of the four principal southern pines represented, covering a variety of sites, age classes and degrees of thinning. There is practically no limit to the scope of an adequate program of experimental thinning, if all age classes, sites and methods of thinning are to be represented for each of the principal species of southern pine.

During the next year some additional thinning work is contemplated. Several plots will be laid out on the Olustee Experimental Forest in northern Florida, which has large areas heavily stocked with second-growth longleaf pine. One of the main objectives of these thinning plots will be to determine optimum spacing of the trees for naval stores production. By locating the plots on the experimental forest, the Station will be able to plan, with assurance of permanency, long-term experiments in which the trees can be thinned at an early age, grown to turpentining size and turpentined under various systems of management designed to obtain maximum continuous production of naval stores and other forest products.

Assistance was given the administrative organization on the Choctawhatchee National Forest in western Florida in drawing up a new set of marking rules to govern the future cutting practices there. In order to demonstrate the use of the revised marking rules, a series of two plots (one cut, one check) was established near the Camp Pinchot Branch Station. The timber is mature longleaf pine turpentined on two faces, representative of considerable area that will be cut on the Forest in the future. Two additional series of cutting plots are planned, one to be in virgin timber unturpentined, the other where but one face has been turpentined out.

No other method of cutting plots were established during the last year, although the possibility of initiating such studies on the Ouachita National Forest in Arkansas was carefully considered in connection with preliminary surveys in search of suitable areas for an experimental forest. At that time the application of Dunning's tree classification to virgin shortleaf pine was given a trial.

Current observations are being made in a number of second-growth pine stands in different parts of the South to determine the size and other characteristics which can be used to indicate what trees develop into good seed-producers, by taking annual counts of the number of cones produced on various types of seed trees.

A number of studies of the development of pine seedlings are under way at the various branch stations, and observations are being made to determine the effect of varying environmental factors or different treatments. The development of longleaf pine seedlings under varying fire histories is being studied in the South Pasture longleaf pine tract near Bogalusa, Louisiana. This is a cut-over longleaf area of approximately 9,500 acres where the soil conditions are remarkably uniform. It was logged between the spring of 1920 and the fall of 1922, and is now covered with longleaf pine seedlings from the 1920 and 1921 seed crops. The young longleaf stands are of particular interest experimentally, because of variations in density of stocking and because different portions up to several hundred acres in extent have had very different fire histories, from complete protection since the year before establishment, through several types of periodic burning, to nine successive winter burns beginning when the seedlings were one year old. Observations and experiments of one sort or another have been conducted on the tract since logging first began, and during the last year the Station undertook to bring together in a single report all the existing records, including dates of logging, extensive seedling counts and height measurements taken since 1925, and dates and boundaries of all fires. This was supplemented by height and stand data on eighteen permanent plots established in 1931. This has given a very good idea of the development of seedling stands of longleaf pine, of the same age and on the same soils, under different densities and under markedly different schedules of burning. In addition, the effect of brown-spot needle blight on height growth and development is strikingly brought out. For the tract in question, which is on typical longleaf pine land, the five most important conclusions reached are as follows:

1. The primary cause of the uniformly complete stocking was the abundant supply of seed from the virgin stand.

2. Fire, after the first growing season, has nowhere seriously interfered with the development of the young pine stands; even single severe fires, after growth started in the spring, have not had appreciable effects on the crop trees. Nine successive winter fires have neither wiped out the stand nor prevented a large number of the seedlings from making height growth.

3. Some of the best seedling growth on the entire tract has taken place where the seedlings have had complete protection from fire since the year before establishment.

4. Brown-spot infection, severe because of the very high density of the seedling stand, has interfered materially with development and height growth of longleaf pine seedlings under about eighteen inches tall.

5. Competition, or intensive brown-spot infection, has apparently delayed the start of height growth. Accidental periodic, and controlled annual winter fires, though not employed as silvicultural tools, have apparently done little harm because of the exceptional over-stocking.

Increase in diameter of virgin longleaf pine throughout the growing season is being observed on ten trees at Camp Pinchot, Florida. The diameter increase is being measured weekly by dendrometers and the rate of growth correlated with temperature, humidity, soil moisture and evaporation. The first season's work indicated that soil moisture is the most important factor influencing diameter growth and that the growing season was continuous from February until the latter part of November.

Studies of the relation of controlled grazing and annual burning to the establishment of longleaf pine reproduction were continued at McNeill, in cooperation with the Bureau of Animal Industry, the Bureau of Plant Industry, and the Mississippi Agricultural Experiment Station. This experiment, which started in 1923, is to demonstrate the possibility of supplying an income from beef cattle on forest pastures during the early stages of regeneration to longleaf pine. The most significant aspect from the forestry standpoint is the fact that longleaf seedlings from the 1924 seed crop, on which the Station's studies are concentrated, have not yet started to make height growth, even in open areas and irrespective of annual fires, and grazing.

Other management projects include studies of the survival and development of longleaf pine under annual or periodic fires or complete protection, the methods of eliminating undesirable trees from the stand by girdling or poisoning, and the effect of grass, brush and tree competition on the development of pine seedlings. These studies will be continued during 1932.

Forestation

In addition to continuing the experimental nursery and planting work at Camp Pinchot, the Station assisted the Regional administrative organization in a study of several state and private nurseries and in a preliminary inspection of planting sites on the Kisatchie (Louisiana) and Ozark (Arkansas) National Forests. Wakeley attended the Planting Meeting at Parsons Nursery in West Virginia, and presented a paper on "Planting Southern Pine". Arrangements have been completed to take care of all the germination tests of southern pine seed used by the Region.

Active work on the manuscript of the forestation bulletin necessitated a review of all available data in the files. For the first time since a bulletin on forestation in the southern region was contemplated, work has been done on the text itself. The rough draft of the section dealing with the seed trade in the South, seed collection, seed extration, cleaning, handling, storing, testing, and special treatments, is practically complete. The completion of this manuscript has precedence over all other forestation work, except remeasurements of established plantations and the seed collection and germination testing required by the forestation program as a whole.

Except at Camp Pinchot, the Station's nursery work was reduced to a minimum. A few drills of southern pines and exotics were grown in a bed furnished by the Parking Commission of New Orleans to provide stock for emergency studies. Last year's studies of state and private nurseries were repeated at the Louisiana State Forest Nursery at Woodworth, La., the Great Southern Lumber Company nursery at Bogalusa, La., the Mississippi State nursery at Perkinston, Miss., the nursery of the Southern Kraft Corporation in Mississippi, the State Forest Nursery at Livingston, Ala., the Forest School nursery at Athens, Ga., and the Forest Service nursery at Russellville, Ark. These studies have yielded systematically arranged information on all phases of nursery practice in fifteen different localities, in some of them for two or more successive years. They have added very materially to our knowledge of nursery conditions throughout the Station territory, of detailed methods of treatment and their results, and of principles of nursery management.

The fifth annual reexamination of the second main group of experimental plantations at Bogalusa was completed in April, 1931. These plantations were established in 1925-26 to check the results of the original plantations established in 1924-25. The annual descriptions and measurements for the first five years on the first series and for the first four years on the second series have been analyzed statistically by means of punch cards. It remains only to analyze the fifth remeasurement on the second series, and summarize the results for the forestation bulletin. The most striking result to date, with all species, is the lead maintained by Grade 1 seedlings over Grade 2 seedlings, and by Grade 2 seedlings over Grade 3, even after five and six years in the field.

What few new studies were made in forestation, other than at Camp Pinchot, were limited to seed. Four results in particular are worth noting.

1. Repetition of previous tests amply confirms the finding that longleaf pine seed can be kept viable and vigorous for one and often for two years by storage at low temperature. Good results have been obtained in both sealed and unsealed glass and metal containers and in paper bags; the only requirements seem to be that the seeds be thoroughly dried before storage, that they be stored promptly after extraction, and that the storage temperature remain constantly in the vicinity of 34 to 40 degrees Fahr. Storage of longleaf pine seed, once considered one of our most difficult problems, may be considered relegated to the background.

2. The hastening and improving of germination of southern pine seed by stratification in moist peat moss at low temperatures (approximately 40 degrees Fahr.) for a month or two before sowing, as developed at Boyce-Thompson Institute, was confirmed for fresh seed and was shown to apply, within certain limits, to stored seed as well. By this means it may be possible to salvage much seed hitherto regarded as a loss.

3. The "referee" test was used systematically for the first time. Matched samples of seed of several species were sent to the Lake States Forest Experiment Station, the Bureau of Plant Industry, Boyce Thompson Institute, the Brown Company, Berlin, New Hampshire, and the forest schools at Yale, Cornell, North Carolina A. & E. College, University of Georgia, and Louisiana State University, for testing in competition with the Southern Station. The results were most instructive. Fresh slash pine seed, for example, germinated anywhere from 6 per cent to 95 per cent, and took from 130 days to only 15 days (the 95 per cent sample) to complete germination, depending almost wholly on the technique employed. The information obtained from these cooperative tests should lead to marked improvement in testing technique for all species of southern pine.

4. Seeds from a longleaf pine cone hand-pollinated with slash pine pollen in the spring of 1929 have produced unmistakable hybrids, intermediate in character between the parent species. Five of the hybrids survived the summer and are at present growing in the Parking Commission of New Orleans nursery.

Measurements (Southern pines)

Volume and yield tables for the four principal species of southern pine have been available since 1930. These tables apply primarily to normal or fully-stocked, even-aged second-growth stands and their application to understocked or to uneven-aged stands, such as predominate throughout the South, is not yet fully understood. There is great need for a better understanding of how second-growth pine stands grow or develop over a period of years so that accurate growth predictions may be made. It is planned to obtain some of this information through the establishment of growth plots in understocked stands of varying densities. One such plot was established during the last year, in an understocked stand of second-growth loblolly pine in north Louisiana. The stand was sixteen years old and the stocking was figured as 56 per cent of normal. This makes a total of four such plots in understocked stands that have been established by the Station. Other plots which will serve as a basis for studying the rate of growth in fully-stocked stands are available in the various thinning, management and fire studies where the check plots are left undisturbed. At present there are thirty-one such plots, representing various-aged stands of each of the four southern pines.

It is planned to increase the number of permanent growth plots in understocked second-growth pine stands as rapidly as available funds and personnel will permit. At least a few such plots should be established each year.

asurements (Bottomland hardwoods)

The acquisition of a certain familiarity with the bottomland hard- od region has been the most important accomplishment of the year. An tensive survey of the Mississippi bottomlands from Cairo, Illinois, to w Orleans, Louisiana, has disclosed several sub-regions, within each of ich forest conditions are distinct. Different soils, drainage (both tural and artificial), and species distribution are the basis for recog- zing these distinct sub-regions.

The identification alone of between seventy and eighty tree species und in the bottomlands has been no easy task, and to this end a consider- le amount of time has been devoted. At least eighteen species ofoak are und in the bottomland region, and the distinctions between some of these e often not well-defined.

The initial research project of the growth and yield work was a ort study to determine the suitability of the present method of volume termination for use in volume table construction for the more important ttomland hardwood species. The volumes of approximately one hundred lled trees of several hardwood species were determined by the use of rm 558-A, according to the accepted procedure, and compared with check lumes obtained by cubing the same trees in four-foot sections by Smalian's rmula. The results of this study indicate that the cubic-foot volumes tree stems determined by the use of Form 558-A are consistently less an similar volumes determined by the use of Smalian's formula. The aggre- te deficiency, however, amounts to only 1.22 per cent of the Smalian lume and it is not thought to be significant.

The working plan for a growth and yield survey study of red gum owing in fully-stocked, even-aged stands has been prepared and approved. itial field work was begun December 1, 1931, and it is planned to complete e field work by the end of 1932.

val Stores

The manuscript, "Experiments in Naval Stores Practice", was completed d is now in press as a Department of Agriculture Technical Bulletin. This the first major naval stores publication to be prepared at the Southern ation and embodies the results of the first five years' controlled tests chipping methods -- from 1923 to 1927, inclusive. The results suggest at increased yields can be obtained through the use of the conservative thods advocated. A copy of the bulletin will be sent to anyone desiring , as soon as available for distribution.

A naval stores poster, designed by members of the Station Staff was inted at Washington and given widespread distribution throughout the val stores region. The poster illustrates graphically the relation of m production to size of tree and points out the unprofitableness of work- g small trees for naval stores.

The number of trees chipped in all experimental work at the Starke, Florida Branch was reduced from 4,094 in 1930 to 2,027 in 1931. A further decrease to 1,377 is contemplated for 1932. Office computations are now completed for all field work through the 1930 season with computations of the 1931 records practically up to date.

In the methods of chipping tests, the main feature was the continued high production of gum obtained during the ninth year of chipping with one-quarter inch high streaks. However, the length of face above the tins is now too great to warrant continuing the work for another season. In the depth of streak test, the sixth year of work brought out to a marked degree the objectionable features of inch-deep work in slash pine. This method resulted in a decided decrease in gum yield accompanied by a noticeable increase in dry face damage. This emphasizes the advantage derived from shallower work, to a much greater degree than was evident at the end of the fifth year of operation (1930). An advance streak in longleaf pine substantiated the claim of operators that a rest period of a few weeks following the cutting of the first streak is good practice and stimulates gum flow. To obtain this result, a five-week period appears to be ample. The greatest increase in yields was obtained during the first few weeks, gradually becoming less pronounced until it disappeared after 12 streaks. The advantage held by the French faces over the American faces during the first three years of work was apparently wiped out during 1931, the fourth season of work. This has probably been caused by a shallowing of the cut on the French faces which were chipped with the flat side of an American puller.

During 1931, a study of interval of chipping, comparing weekly chipping with two, three and six times a week chipping, was begun on the Kingsley Tract. The practical application of these results is limited, for the present, to special cases such as one where it is desired to obtain a quick realization from second-growth longleaf prior to removal of the trees. In this experiment, 130 second-growth longleaf pines were divided into 13 comparable groups of 10 trees each. The season's results indicate very promising possibilities for frequent chipping, especially in the two and three times a week intervals. The season yields of dip and scrape from six times a week chipping were approximately three times those from once a week chipping, while the three times a week chipping yields approximately two and one-half times as much and the two times a week slightly less than twice as much as the once a week chipping. The estimated average cost of production per unit for six times a week chipping is 80 per cent as much as that for once a week chipping, whereas the three times a week is 73 per cent and the two times a week 77 per cent as much as the once a week chipping. Thus the estimated cost of production is considerably less when the trees are chipped more often than the normal practice of once a week chipping, mainly because many of the fixed charges or "overhead" expenses, such as for fire protection, taxes, maintenance, and supervision are independent of yield and are constant for all intervals of chipping. No apparent injury or detrimental effect upon the vitality of the trees due to the heavy strain of frequent chipping was noted for the first thirty-one weeks' work. Work is being continued on this experiment without any winter resting period.

The gum yield projects gave some interesting results. Thirty-nine per cent of the trees in the Kingsley Lake longleaf thinning plot are either dead or dry-faced to such an extent that turpentining work on them has been discontinued. These trees were worked with two or more French faces per tree. From the standpoint of gum production, the operation was distinctly unprofitable. Although full details are not available, it seems probable that overcrowded stands where the crown legnths are less than one-sixth of the total height of the tree cannot be chipped profitably. The stand contained 700 trees per acre, 33 years old.

The gum and weather data gathered in 1926, 1927, and 1928 have been thoroughly analyzed. The results show a close correlation between air temperature and yield of gum from both slash and longleaf pine, on the first day after chipping. Soil temperature and evaporation also were found to be correlated with gum yield, but to a much smaller extent. Trees chipped when the average air temperature was as low as 40 degrees Fahr. produced very little gum on the first day after chipping but yields increased with increase in temperature. Soil temperature was found to be most effective in influencing gum yield when it was slightly above air temperature; thus, when the soil temperature was a few degrees below air temperature, considerably less gum flowed than when the soil temperature was a few degrees above air temperature. Evaporation had but a slight net effect on yield; a range of 40 grams in water evaporation being associated with only 10 grams per tree variation in gum yield, whereas a soil temperature range of 34 degrees was associated with 35 grams variation in gum yield and an average air temperature range from 40 degrees to 85 degrees with 120 grams in gum yield.

The gum yield on the second, third, or more days after chipping was not found very closely correlated with weather factors, but seemed to be largely dependent upon the first day's yield. The heavier the yield on the first day, the lighter the yield during the remainder of the interval between streaks. The results of this study are being prepared for publication as a Government Bulletin.

Gum production is most active in the morning hours and slows down or may stop entirely in the afternoon while the air temperatures remain relatively high. Slight upward rises in temperature result in an immediate increase in gum yield. It has been suggested that daily or hourly changes in stem size as shown on a dendrograph may reflect changes in internal tree pressure, which in turn may affect yields. Transpiration trends seem to parallel gum yield trends, at least theoretically. Some fundamental physiological studies are needed to clear up these points and throw light on whether temperature changes effect the rate of gum production through altering the gum viscosity or by influencing the internal tree pressures. Additional research is undoubtedly needed before this study can be completed. Practically all of our methods of chipping studies are dependent upon the answer to this fundamental question.

Naval Stores and Fire

A study of the relationships between fire and resin yields in naval stores operations has been under way since 1930. Gum yields are being obtained from burned and unburned second-growth slash pine plots in northern Florida. During the last year extensive surveys were made in various parts of the southern pine region with the particular object of finding areas which had not been burned for a number of years. Several such locations were found and conditions compared with those on adjacent frequently-burned areas. Soil samples were obtained from burned and unburned soils and these are being analyzed at the Florida Agricultural Experiment Station to obtain a measure of the effect of burning on the soil. A progress report is being prepared. The effect of fire on tree growth as reflected in soil changes will be studied by means of phytometers and lysimeters, using soil from burned and unburned areas. The influence of the decomposition of litter and duff on tree growth will also be included in this study, inasmuch as frequent fires prevent the accumulation of litter, which should be reflected in gum yields.

Erosion-Streamflow

Erosion investigations, begun in 1929, have been confined mainly to the Silt Loam Uplands of Mississippi, one of the most seriously eroded sections of the entire country.

An extensive erosion survey has been made of nine counties in this northwestern Mississippi region. The following table indicates the extent of erosion for the total upland area covered by this survey:

Type of Land Use	Per Cent of Total Land Area	Per Cent of Total Land Area Eroding
Cultivated land	36	12.2
Pasture land	20	8.2
Abandoned land	23	7.3
Woodland	21	0.0
Totals	100	27.7

In two counties it was found that over 40 per cent of the area is actively eroding. Assuming that the nine counties studied are representative of the 4,000,000 acres comprising the Silt Loam Uplands of northern Mississippi, at least 1,000,000 acres in this area are actively eroding, which indicates the seriousness of the soil erosion problem there.

In order to study the survival and growth of various tree species on eroded sites, and to note their effectiveness in controlling erosion, six areas of about one acre each were planted during the spring of 1931.

hese areas were selected to represent typical soil types on which erosion s serious in northwestern Mississippi. Approximately 9,000 seedlings, rincipally black locust, red oak, Red River oak, loblolly, shortleaf and ash pines, were planted on the slopes of eroding gullies or in rows from to 6 feet apart on areas where erosion had not progressed to such a egree. The slash pine plantings are several hundred miles north of its atural range.

Subsequent examinations indicate that (1) sandy sites favor the rowth and survival of shortleaf and loblolly pines; (2) as a reclaimer f gullies, black locust is by far the most effective of the species ried; (3) black locust grows best on silt loam soils and does poorly on ery sandy sites receiving no treatment; (4) preparation of the gully by reaking in the banks and catching the outwash resulted in better growth nd survival in most cases. For example, the black locust on three of the reas averaged three times better height growth on outwash soils than hen grown on top of the bank on the uneroded and undisturbed soil surface.

Further studies testing other species, other planting methods and arious combinations of forest tree seedlings and herbaceous vegetation are ontemplated for 1932. The effect of various types of dams for erosion ontrol, the use of vegetation in connection with dam construction, and ore economical means of preparing large gullies for planting, are a few f the problems needing investigation.

Eight small plots were established during the summer of 1931 near olly Springs, Mississippi, in cooperation with the Mississippi Agricultural xperiment Station, to study the influence of vegetative cover and land se upon the rate and amount of surficial run-off and soil loss. The fol- owing conditions were represented:

1. Cultivated land (2 plots).
2. Old field abandoned 7 years (mineral soil exposed and eroding) (2 plots).
3. Improved pasture (bermuda grass).
4. Native grass cover (Andropogon sp.).
5. Twenty-year-old black locust-osage orange plantation (on field formerly gullied).
6. Scrub oak woodland cover (typical of inferior second-growth forest).

These plots are located on slopes of 10 per cent and on similar oils. The plots are 3 by 12 feet in size, and the two sides and upper nd are isolated by sheet metal strips sunken into the ground 5 to 6 inches. heet metal tanks, sunken into the ground at the lower end of each plot, erve to catch all run-off water and eroded material from each area.

Between August and December 1931, the data for 15 rain storms were collected from these run-off plots. While the results are of a tentative nature, the trends seem consistent. The preliminary results are summarized in the following table:

Type of Cover	Average per cent of rainfall which ran off*	Total pounds per acre of eroded material
Native grass	.38	73
20-year black locust-osage orange plantation	4.88	109
Improved pasture (bermuda grass)	6.98	36
Scrub oak woodland	7.22	109
Abandoned old field (average of duplicate plots)	44.39	44,183
Cultivated land (Average of duplicate plots)	48.10	38,853

---

* Total rainfall from 15 storms = 12.53 inches which fell during a period of 16 weeks. Normal annual rainfall is about 50 inches.

With such a low per cent of run-off from the plots with a vegetati cover, it is not surprising that the total amount of eroded material is almost negligible. In contrast, the cultivated and barren plots lost large amounts of mineral soil. Of the soil washed from the barren site o abandoned old field, over half was removed by three rains. A single rain less than an inch washed soil from one of the cultivated plots at the rat of 4.37 tons per acre. The heaviest loss occurred on one of the barren plots when soil equivalent to 5.2 tons per acre was removed by a rain of 2.15 inches.

Because conditions under the scrub oak cover were not comparable t those under a mature forest, additional run-off plots were established in duplicate during September 1931, under the latter type of cover. On the two forested plots, the results from six storms, between October and December 1931, totalling 7.01 inches of rain, were as follows:

Average per cent of rainfall which ran off	.54
Total pounds per acre of eroded material	73

Most of the run-off from the forest plots occurred during only two out of the six rains. The material washed off consisted of a very small amount of leaf litter and no mineral soil was lost.

These results indicate that keeping the soil covered with vegetation probably affords one of the most effective and economical means of controlling soil movement. The technique of reclaiming gullies by establishing forest and herbaceous cover needs much additional investigation.

The present erosion studies under way at Holly Springs will be continued. Measurements on the run-off plots will be taken currently during 1932. Additional plantations will be established to determine the effect of forest planting in rehabilitating gullied lands.

Financial Aspects of Private Forestry

The future of the business of growing crops of pine timber in the South by farmers, corporations, and other owners of private lands will depend upon the possibilities of profit. The plan for the financial aspects of timber-growing project under way by the Southern Station calls for an analysis of information taken on a number of areas where forests are being grown and harvested. These data on costs and returns obtained from farm woodlands and from many and varied examples of larger holdings will be pieced together and analyzed to bring out the economic factors and conditions which favor as well as those which militate against the growing of timber crops as a business venture. Results will be made as specific as possible so that owners of forest land may apply them to their particular conditions.

The project has been divided into two parts. First, in order to obtain a general background, a study of average conditions on the farm woodlands was undertaken by county-wide surveys in each of the principal southern timber types. Following this, case studies of specific examples of various types of holdings where many phases of forestry and methods of utilization are practiced will complete the picture.

This project has been under way for two years with practically the entire time spent on county-wide surveys. At the end of the first year, field work had been completed on seven county-wide surveys (Alcora County, Miss., Appling County, Ga., Lee County, Ala., Beaufort County, N. C., Washington County, Fla., Bradford County, Fla., and Hamilton County, Fla.) and first drafts of reports had been completed on four of the counties (Alcorn, Appling, Lee, and Washington). During the last year, two of the original reports, Appling and Washington Counties, were revised, and the latter was published by the Florida Forest Service as Bulletin No. 7, June, 1931, under the title "Financial Aspects of Growing Southern Pine, Washington County, Florida." Preliminary reports were prepared for the remaining three counties. Three additional counties (Hempstead County, Ark., Polk County, Texas, and Union Parish, La.) were covered by field work using far more intensive methods, and reports of these counties are now being prepared. Plans for the coming year call for but one additional county survey (Pearl River County, Miss.), making a total of twelve in all. The counties selected for study were pretty well distributed over the territory of the Southern Station and represent all the important pine types of the region. Much of the coming year will be devoted to case studies of large and small holdings varying as to final products, timber types, stands and forestry practices.

A few facts regarding three counties studied in Florida will be included in this report. These three counties are Hamilton County in north Florida, Bradford County in northeast Florida, and Osceola County in the southern part of the state. Hamilton and Bradford are very similar as to stands of timber, both having essentially young stands (average age 20-25 years) of longleaf and slash pine with poor stocking (14-16 per cent of normal). The board-foot volume per average acre of pine trees 8 inches and larger in diameter at breast height was 980 for Hamilton and 1,140 for Bradford, and the average annual growth per acre was 115 board feet for Hamilton and 43 board feet for Bradford. The smaller increment in Bradford County is due to heavy mortality in trees remaining from the virgin stand which have been boxed for turpentine, and which form a larger proportion of the stand than they do in Hamilton County. In both counties, well-stocked stands were also found with increments running up to 500 or even 700 board feet per acre per year. The average income per acre of forest land in 1929 from the two counties was as follows:

Cash Income	Hamilton	Bradford	
Naval stores leases	$ .34	$ .32	
Timber stumpage	.36	.80	
Total cash income	$ .70	$1.12	
Excess of Increment over Cut	$ .21	$ .53	Depletion
Income corrected for depletion	$ .91	$ .59	
Non-cash Income-fuelwood and grazing	.10	.17	
Total	$1.01	$ .76	
Taxes	$ .13	$ .56	

It is evident that Hamilton County, even with average stands poorly stocked (14 per cent), presents favorable inducements for profitable timber operations (1929) while profits in Bradford County were practically confiscated by taxes. With modified taxes and better-stocked stands, timber operations in these two counties should prove profitable under normal market conditions.

Osceola County in southern Florida presents a very different picture. The sparse original stands of poor quality virgin timber have been cut from 75 per cent of the area, and very little restocking has taken place, and practically no possibilities of profitable timber operation can be shown. It seems inevitable that the land area reverting to the state for taxes which range from $.13 to $.69 per acre will increase beyond the 1929 stage, which is 18 per cent of the county area.

In considering the ten counties studied to date, unfavorable conditions for timber growing were as follows:

1. Stands understocked or deficient in number of trees.
2. High taxes, particularly in certain counties.
3. Poor forestry practices which penalize the future possibilities of profit.

4. Poor marketing methods.
5. Depression in agriculture encouraging over-cutting of woodlands to obtain ready cash.
6. Poor regeneration of longleaf pine due to frequent uncontrolled fires, hogs, and lack of seed trees.
7. Poor quality of soil on certain areas.

Conditions favorable to growing timber as a business proposition were as follows:

1. Rapid growth of southern pines, except on the poorer sites.
2. Good natural regeneration of southern pines except on some of the cut-over longleaf pine lands.
3. Large increments per acre under very simple management, chiefly protection from uncontrolled fires and cutting conservatively.
4. Available markets sufficient to guarantee reasonable profits for well-stocked areas.
5. Reasonable costs, including taxes, fire protection, labor, etc., except for limited parts of the region.
6. Diversity of forest products, lumber, naval stores, railroad ties, piling, poles, pulpwood, etc.
7. Availability of good forest land at reasonable cost.
8. Relatively low planting costs and rapid growth of southern pines in plantations.

The studies of the financial aspects of timber-growing thus far indicate that southern pine lands, if reasonably stocked, promise fair return on their present values.

New Public Domain

A forest economic study of the "New Public Domain" was inaugurated in the South on December 1, 1931. During December, Assistant Forest Economist R. B. Craig, who is in charge of the project, spent three weeks in Mississippi obtaining pertinent data on taxation and tax-delinquency, and acquainting himself with field conditions.

During 1932, the seven other states in the jurisdiction of the Southern Station will be visited for the purpose of obtaining a general view of the tax-delinquency situation in each. Following this broad survey, one state will be selected for more intensive study.

The objectives of this study are: (1) to determine the location, extent, and status of tax-delinquent lands in the eight states under the jurisdiction of the Southern Forest Experiment Station; (2) to determine the causes of, and trends in, tax-delinquency, particularly as it affects forest land; (3) to determine the desirability of utilizing this land for forest production and the desirable line between Federal, state and local public and/or private ownership; and (4) to work out and recommend practical measures for the handling and use of these lands.

In each state, certain typical counties will be selected for intensive study on the basis of the prevalence of tax-delinquency and the potential forest possibilities of their public domain. These data will later be extended to the whole state. Cooperation from the individual states will be an important aspect of the project.

Forest Survey - (Bottomland Hardwoods)

The first appropriation for the Forest Survey in the South made $25,000 available July 1, 1930, for the inauguration of work in the bottomland hardwoods of the Mississippi Delta region. As mentioned in last year's report, less is known concerning the present conditions, potential production, and profitable land use in the southern bottomland hardwood region than for any other major forest region in the country. Lack of knowledge on tree species, forest types, differentiation of sites, and the mode of attacking the problem in general made it necessary that careful and thorough preliminary investigations be carried on prior to the preparation of a working plan and actually starting field work. Considerable time was spent in outlining and testing out plans in various parts of the bottomland region in order to develop a method for the Survey.

Actual field work on a preliminary test cruise was started in northeastern Louisiana on March 25, 1931, and by June 15, 1931, the 503,000 acres in East and West Carroll Parishes had been covered. Data were taken on ten separate survey lines 3 miles apart, each of which was run due west beginning at the Mississippi River. Along these lines, data were taken on quarter-acre sample plots every ten chains. It took two crews of three men each two and one-half months to gather the required data for these two parishes. The data were then partially worked up in the New Orleans office before being sent to Washington for further analysis in the Office of Forest Measurements.

This preliminary survey gave accurate data on the area of various timber types and conditions and the volume of timber for the two parishes, and also served to test out the tentative working plan. Some changes were necessary before the final survey could be started on a large scale.

In East and West Carroll Parishes, the preliminary survey showed 64 per cent of the land in forest and 831 million board feet (gross scale), of which 36 per cent by volume is in virgin timber. However, the area in virgin timber comprises only 12.6 per cent of the total forest area. Tables have been prepared showing the total board-foot volumes by species, by condition (virgin, second-growth, old fields, etc.), by sites (bottomland, terrace, swamp, river margin, new batture land, and uplands), and by forest types (nine principal types will be differentiated). The total volume has also been separated on a basis of log grades. A cull factor of 1.79 per cent due to visible defects in merchantable trees due to fire, rot, etc., was arrived at.

The analysis of the preliminary test indicated that the forest resources of the bottomlands can be obtained within satisfactory limits of accuracy by running lines 10 miles apart and taking detailed information on sample plots of one-quarter acre or less in size, every 660 feet along each line on the forest lands.

Fire damage was noted on 82.5 per cent of the total number of plots taken in the preliminary survey. In spite of the relatively moist nature of the bottomlands, there are periods of extreme drought when the forest areas are subject to severe injury from fire. From a study of the fire scars, it was found that fires were particularly numerous in 1916, 1924, and to a lesser degree in the summer and fall of 1930, and the early spring of 1931. Fires in themselves seldom destroy hardwood trees, but fungi causing butt rot, heart rot or other decay, invariably follow fire and gain entrance through the fire scars.

With a few minor exceptions, no adequate and reliable volume tables for the bottomland hardwood region have been made. Red gum and green ash volume tables, based on measurements taken in 1928, were made in March, 1931. Additional trees of all species in old and second-growth stands were measured during the summer of 1931. Analysis of these data showed that a definite relation exists between the breast-high diameter outside of bark and the diameter inside of bark at the end of the first 16-foot log. However, the ratio varies for different species and sizes. Above the first 16-foot log, the taper for most hardwood species is quite uniform. These ratios and tapers have been used in making up a series of volume tables based on the Scribner Decimal C Log Rule, and the species fitting each ratio table have also been determined.

Measurements were made to determine the volume of top and limbwood in hardwoods for each 1,000 board feet, log scale. The material in the tops and branches of 187 trees in Louisiana was measured in four-foot lengths and the volumes calculated. The results from these data showed a volume of about 1 1/4 cords per thousand board feet log scale (using 90 cubic feet per cord) for trees 18 to 20 inches d.b.h. and about one cord for trees 28 to 35 inches d.b.h.

It is expected that work on the final basis will be begun in the bottomland hardwood region in the state of Mississippi early in 1932, depending on field conditions there.

Forest Survey - (Southern Pine)

$40,000 were made available July 1, 1931, to inaugurate the Forest Survey in the southern pine region. A tentative working plan for this phase of the work was prepared, the preliminary field work was begun in Pearl River County, Mississippi, October 26, 1931, and was practically completed by the end of 1931. In the pine survey, a plan similar to the one used for the hardwoods was followed, though it was necessary to set up different forest types and sites to fit the conditions. Special emphasis was placed on a determination of the amount and distribution of pine seed trees and reproduction on cut-over areas. Of the total area of 510,000 acres in Pearl River County, approximately 90 per cent is forest or cut-over land. The present forest conditions in per cent of total area of the county are approximately as follows: virgin or culled timber, 10 per cent; cut-over with some seed trees, 47 per cent; cut-over and denuded, 29 per cent; second-growth, 4 per cent. The balance of 10 per cent is in cultivation or in non-forest types.

Many inquiries as to timber stand and growth for particular parts of the South indicate the need for just such information as the Survey is to obtain. In Mississippi, the Mississippi Research Commission has agreed to cooperate with the Forest Survey in obtaining information concerning the timber resources of that state. This cooperation will amount to $25,000, contingent upon the action of the next Legislature.

The hardwood and pine surveys will be combined under one organization, with crews alternating between the two regions according to the best working periods in each. Active work in the pine region should get under way in the spring of 1932. The rate of progress will depend not only on the extent of the Federal appropriations but also on the amount of cooperation furnished by forest land owners, associations, states, etc.

Forest Pathology (Pine)

Studies of the diseases of trees and forest products were continued by the pathologists assigned to the Southern Station by the Bureau of Plant Industry. The study of the seedling disease of longleaf, caused by Septoria acicola, was continued as a major project. Minor studies dealt with basal decay in southern pines and rotting of slash.

The larger part of the work with the brown-spot needle blight of longleaf pine seedlings has been concentrated on areas of natural reproduction near Bogalusa, Louisiana, but near the end of 1931 an extensive survey was made to determine the prevalence of the disease in various sections of the South and to obtain additional information on the relation of the disease to fire.

Slow-growing seedlings are being sprayed and measured each summer. When the growth of 20 sprayed plots was compared with that of 20 unsprayed, it was found that the sprayed seedlings averaged taller in 17 out of 20 pairs of plots. Had the treatments been ineffective, it would be expected that the seedlings on 10 out of 20 sprayed plots would be taller and 10 shorter than those on the corresponding unsprayed plots. This difference of 7 plots signifies that the greater growth is due to control of the disease through spraying, which is the only way in which the two groups of seedlings have differed in treatment.

The effect of the brown-spot on the development of forest plantations is being tested by spraying several hundred seedlings once or twice a month. By the end of two years in the field, average diameter growth of unsprayed stock was one-third below that on adjacent sprayed plants. There was a mortality of 8 per cent among unsprayed plants, ascribed to the defoliation effect of the disease, compared with no mortality where sprayed.

A study of the relative effectiveness of different sprays for the 1931 foliage indicated that lime-sulphur gave the most effective protection against the disease. The treatments listed in the order of relative effectiveness in 1931 are: lime-sulphur, Bordeaux mixture, zinc-sulphate plus lime, casein, and colloidal sulphur. It has been demonstrated that casein, which was at first employed solely as an adhesive, materially reduces brown-spot infection when used by itself.

Data have been gathered on the rate of seasonal development of the brown-spot. Analysis of the figures indicates that in the dry growing season of 1930, the highest periodic increase in disease occurred during the interval from September 15 to September 30 after a drought of early spring and summer had been broken. In the wetter season of 1929, the greatest increase in disease took place between July 15 and July 30.

The influence of grass and sedge on needle infection is being studied. By denuding various areas of all grass and herbaceous vegetation, the amount of disease was doubled for the first season and tripled for the second. Heavily mulched plots have been established where the grass is being kept out to determine the effect of root competition on seedling development. Chemical fertilizers have been applied to a number of areas to determine if their use will result in a reduction of the disease.

In an extensive survey of the longleaf region from Texas to South Carolina, involving 20 localities, it was found that a single fire reduced the disease on all areas for the first season and to a lesser extent on 14 areas for the second.

Forest Pathology (Hardwoods)

The hardwoods of the lower Mississippi Valley have been given practically no attention by forest pathologists in the past. Work in this field was inaugurated in July, 1931, when new appropriations were made available for that purpose. The first work was begun in Louisiana by Dr. L. O. Overholts and Frank Kaufert. Collections of wood-rotting fungi were made and data obtained as to the type and importance of the more common hardwood decays. The season was an ideal one for collecting fruiting bodies of the wood destroyers. Some 450 collections of sporophores and their associated decays were made. Although the final identifications have not been determined, the group promises to yield at least a few new species. It is believed that the collection included most of the important wood-destroying fungi in the hardwood region. Two fungi were found fruiting upon live red gum trees, which was the first case of record where sporophores had been found upon living trees of this species. Pure cultures of the most important decay-producing organisms were made in the field from the fresh material.

A study of the relation between fire scars and heart rot of living hardwoodstrees was begun. The data thus far collected seem to indicate that 90 per cent or more of the decay in merchantable hardwoods originates from fire scars. It has not yet been possible to work out a relationship between age, size, or shape of fire scar and the extent of decay. Decay which enters through fire scars affects not only the merchantable timber, but may be even more damaging to young stands; it appears to be the cause of high mortality in immature timber stands. More work upon these problems is necessary before final definite statements can be made.

Products Pathology

Work in forest products pathology has been largely a continuation of devising efficient methods for controlling sap stains and molds in domestic and export lumber and logs. The results of former tests have been largely confirmed by the tests in 1931; the ethyl mercury chloride and the borax treatments have continued to give satisfactory control.

Two other lumber dips tested at several mills this year gave encouraging results, sodium tetrachlorphenolate on hardwoods and sodium orthophenyl phenate on pine. An ethyl mercury compound which showed up well in the preliminary tests is now being sold under the trade name of Lignasan and has been adopted by one hundred or more southern pine and hardwoodmills with results generally satisfactory. Investigation of the few cases where the results were unsatisfactory showed that the methods of application were often at fault. Efforts are being made by the manufacturers of Lignasan to increase the efficiency and permanence of their product and to reduce the possibility of injury by its toxic properties. Borax has not been adopted as yet, although tests are being run at the present time by borax manufacturers, the results of which, if satisfactory, will no doubt stimulate its use. Other promising compounds need to be tested further before definite recommendations can be made; their adoption by the lumber industry will then depend largely on the manufacturers. Soda, the principal dipping compound used during the last 20 years, has been shown as definitely inferior in the preliminary tests.

Although a few compounds have been found to give satisfactory contro of stain and mold, the problem of finding an efficient non-mercurial compound that will be definitely safe from the standpoint of toxicity to humans and equally effective on both pine and hardwoods is yet unsolved. Our preliminary small-scale tests this year have revealed one treatment, a 0.48 per cent solution of sodium 2 chloroorthophenyl phenolate, that give very promising control of stain on both pine and hardwoods. No commercial scale tests of this compound have yet been made; it is hoped that they can be started in 1932.

Application of stain control methods at portable mills is an important problem which needs attention and on which comparatively little work has been done. It is planned to begin a study of this problem during 1932.

Commercial tests in 1930 of a number of chemicals showing promise in preventing deterioration in stored logs revealed two or three to be effective in controlling stain and decay, but none definitely preventing insect attack. The insect control phase presents a difficult problem and the search for a combination stain-preventive and insect repellent will be carried on during 1932 with some help from members of the Bureau of Entomology. Recent small-scale tests have revealed one or two promising chemicals which will be tested on a commercial scale in the near future.

Preliminary tests of a number of chemicals were established to determine their value as pre-treatments for southern pine poles, posts, and piling.

In addition to the field work outlined above, a number of laboratory studies, including the dissemination phases of the stain problem, relative durability determinations, and strength tests of treated and untreated air-seasoned lumber, are planned for 1932.

Miscellaneous

In addition to the current Station projects, considerable time was spent by a number of the Station men in revising estimates of present forest areas, timber stands, current and potential timber growth and forest depletion for the individual states and various forest types in the southern region. This information was called for in connection with a revision of the last report of this kind made by the Forest Service in 1920 (Senate Resolution 311, Capper Report). The present revision represents the best information on the general forest situation in 1930 that could be had from readily available sources. Accurate data will not be had until such time as the field can be covered by the Forest Survey.

Several members of the Station staff assisted in the preparation of a forest type classification for the southern forests, in cooperation with the forest type committee of the Society of American Foresters.

During the year a card index was prepared for the Station photograph collection. This involved the typing of about 12,500 cards, which are grouped according to subjects and which refer to approximately 5,100 photographs taken since the Station was established.

A13.27.

[illegible] DEPARTMENT
[illegible] LIBRARY

R - SS
Investigative Program

TWELFTH ANNUAL REPORT

of the

SOUTHERN FOREST EXPERIMENT STATION

New Orleans, La.

For the period - January 1, 1932 to December 31, 1932.

April 27, 1933.

CONTENTS

Page

General - 1

Centers of work - - - - - - - - - - - - - - - - - - 3

Olustee Experimental Forest - - - - - - - - 4

Natural Areas - - - - - - - - - - - - - - - - - 6

Current Investigations- - - - - - - - - - - - - - 6

Fire- 6

Fire Statement - - - - - - - - - - - - - - - 7

Management- 10

Natural reproduction -- - - - - - - - - - - 10

Methods of cutting - - - - - - - - - - - - - 11

Thinning- - - - - - - - - - - - - - - - - - - 12

Forestation - - - - - - - - - - - - - - - - - - - 14

Measurements- - - - - - - - - - - - - - - - - - - 17

Southern pines- - - - - - - - - - - - - - - 17

Bottomland hardwoods- - - - - - - - - - - - 17

Naval stores- - - - - - - - - - - - - - - - - - - 18

Erosion-streamflow - - - - - - - - - - - - - - - 21

Financial Aspects of Private Forestry - - - - - - 25

New Public Domain - - - - - - - - - - - - - - - - 29

Forest Survey - - - - - - - - - - - - - - - - - - 30

Forest Pathology- - - - - - - - - - - - - - - - - 34

Pine - 34

Hardwoods- 35

Products - 35

STAFF
SOUTHERN FOREST EXPERIMENT STATION
January 1, 1932 - December 31, 1932

E. L. Demmon	Director
I. F. Eldredge	Principal Forest Economist
W. E. Bond	Forest Economist
G. H. Lentz	Silviculturist
A. E. Wackerman	Forester
W. G. Wahlenberg	Associate Silviculturist
P. C. Wakeley	Associate Silviculturist
Lenthall Wyman	Associate Silviculturist
L. J. Pessin	Associate Forest Ecologist
*P. V. Siggers	Associate Pathologist
Henry Bull	Assistant Silviculturist
R. B. Craig	Assistant Forest Economist
E. W. Gemmer	Assistant Silviculturist
V. L. Harper	Assistant Silviculturist
M. M. Lehrbas	Assistant Forest Economist
R. K. Winters	Assistant Silviculturist
F. K. Beyer	Junior Forester
C. A. Bickford	Junior Forester
R. A. Chapman	Junior Forester
J. W. Cruikshank	Junior Forester
V. B. Davis	Junior Forester
E. B. Faulks	Junior Forester
E. A. Foster	Junior Forester
F. D. Heyward	Junior Forester
T. A. Liefeld	Junior Forester
H. G. Meginnis	Junior Forester
J. G. Osborne	Junior Forester
C. F. Olsen	Junior Forester
J. A. Putnam	Junior Forester
R. R. Reynolds	Junior Forester
A. R. Spillers	Junior Forester
P. R. Wheeler	Junior Forester
T. E. Pease	Senior Forest Ranger
R. M. Barnett (Florida Agricultural Experiment Station)	Agent
*A. D. Chapman	Agent
*Theo. C. Scheffer	Agent
John A. Lubbe	Junior Administrative Assistant

Vera S. Lind	Senior Clerk
Effie H. Hunt	Clerk-Stenographer
Bettie C. Busch	Clerk (Statistical)
Mary C. Regan	Assistant Clerk (Statistical)
Lucille P. Olsen	Junior Clerk (Statistical)
Camelia M. Larsen	Assistant Clerk - Stenographer
Agnes G. Terburg (In Cooperation with District Forest Inspector)	Assistant Clerk - Stenographer
Elizabeth Bergland	Junior Clerk - Stenographer
Marie M. Flad	Junior Clerk - Stenographer
Mary S. Gloger	Junior Clerk - Stenographer
Ruth Marshall	Junior Clerk - Stenographer
May M. Patchett	Junior Clerk - Stenographer
Leo W. Cooper	Junior Messenger

Temporary Field Assistants

F. W. Bennett
Raiford F. Brown
Lincoln Ellison
T. C. Evans
*Geo. H. Hepting
C. S. Herrick
Morris A. Huberman
Frank A. Ineson
A. G. Jacobson
Frank Kaufert
W. L. Keel
N. J. Lauria
T. E. Maki
*A. F. Verrall

* - Office of Forest Pathology, Bureau of Plant Industry, cooperating with the Southern Forest Experiment Station.

R-SS
Investigative Program April 27, 1933.

TWELFTH ANNUAL REPORT
of
SOUTHERN FOREST EXPERIMENT STATION

January 1, 1932, - December 31,1932

General

This report discusses briefly the progress of forest investigations under way at the Southern Forest Experiment Station during 1932, together with plans for 1933. It marks the twelfth in a series of reports that have been issued annually since the Station was established in July, 1921. This regional forest experiment station serves the territory extending from Georgia and Florida westward to eastern Texas and Oklahoma, and including a land area now in forest or available for timber growing of approximately 156,000,000 acres.

The South is greatly in need of information that can best be obtained through a broad forest research program. The Southern States constitute the most important forest region in the United States, a territory capable of producing one-third of the nation's timber requirements. Solution of the South's problems of forest growth, forest protection, and forest land use is necessary for the region's fullest economic development. Forest industries have played a prominent part in the region's economic advancement, and present trends in industrial forestry point with certainty to future expansion in forestry activities. The demand for the information which forest research can supply is becoming increasingly insistent. It is generally recognized that forest research is a long-time undertaking suited to public rather than to private enterprise.

The South embraces such a large territory and such a variety of forest types and conditions that an adequate forest research program calls for field investigations at many points throughout the region. None of the major forest research problems of the South is limited to any one State. On the other hand these problems must be worked out separately for different parts of the region, as variations occur even within the same forest type. These facts have been taken into account as far as practicable in formulating the programs of the Southern Forest Experiment Station. Although the Federal research work under way at this Station has greatly expanded since 1921, much more must be undertaken before the needs of the region as a whole can be adequately met.

Practically all the forest land in the South is privately owned. National forests in the Station's territory include but a very small part of the South's forest land, and State forests even a smaller part.

AREA OF NATIONAL FORESTS AND STATE FORESTS IN EIGHT SOUTHERN STATES - June 30, 1932.

	National Forests				State Forests	
State	Name of forest	Net area acquired	Approved for purchase but not acquired	Total	No. of units	Net area
Alabama	Alabama	129,874	4,661	134,535	12	8,905
Arkansas 1/	Ouachita	826,883	17,254	844,137	1	25
Florida	Choctawhatchee	248,465	4,066	252,531	0	-
	Ocala	183,960	543	184,503		
	Osceola	145,403	2,358	147,761		
Georgia	2/				1	100
Louisiana	Kisatchie	75,598	10,252	85,850	2	5,888
Mississippi	Homochitto		65,030	65,030	1	23,000
Oklahoma	Ouachita) (Kiamichi)	54,579	6,910	61,489	0	-
	Wichita	61,480		61,480		
Texas					4	6,434
Total		1,726,242	111,074	1,837,316	21	44,352

1/ - Ozark National Forest (428,806 acres) in northern Arkansas not in territory of Southern Station.

2/ - Cherokee (195,700 acres) and Nantahala (134,577 acres) National Forests in mountains of north Georgia not included.

The Southern States are financially unable to carry on all the forest research work which they need, nor is it probable that they will be able to do so for many years to come. A considerable proportion of privately owned forest land is in the hands of small landowners (mostly farmers) who cannot be expected to contribute toward a forest research program other than through regular taxation channels. Some of the more progressive of the large corporate landowners are assisting in the furtherance of the Federal forest research program by setting aside portions of their land for studies by the Southern Station. The national forest administrative organization is carrying on a limited quantity of administrative research.

It is believed that the main part of an adequate forest research program for the South can be carried out most satisfactorily on Federally owned land, under the direct supervision and protection of the Federal Government. This means that a well rounded forest research program must be conducted on those national forests that typify the important forest conditions of the region. Where suitable national forest land is not available for research purposes, the acquisition of experimental forests should be included in the national forest acquisition program.

Personnel

Two vacancies on the staff were filled during 1932: A.E. Wackerman, as Forester, was assigned to the Financial Aspects of Forestry project, beginning January 25th, and Capt. I.F. Eldredge assumed the directorship of the Forest Survey for the South on March 15th. Each of these men came to the Station backed by several years of experience in private forestry work in the South.

Junior Forester R.A. Chapman was on detail in the Office of Forest Measurements at Washington during the entire year; Junior Forester V.B. Davis from February 1st to April 1st, 1932.

On December 31, 1932, the Station staff included 35 technical men, a clerical force of 14, and 3 technically trained field assistants.

CENTERS OF WORK

The Station's field investigations during 1932 were centered at six branch stations: Urania, Louisiana; Bogalusa, Louisiana; McNeill, Mississippi; Camp Pichnot, Florida (Choctawhatchee National Forest); Starke, Florida; and Lake City, Florida (Olustee Experimental Forest, The Osceola National Forest). Two of these centers of work are located on national forests; the remainder are on private forest land, where the station is cooperating with the landowners on areas leased by the Station for experimental purposes.

There is urgent need for the acquisition and development of a complete series of experimental forests throughout the South, which can serve as field centers of work, assure permanency for the Station's field investigations, and at the same time be used for demonstration areas. These purposes can best be fulfilled in the experimental forests are Federally-owned and under the direct protection and control of the Station. It is estimated that a total of 17 such experimental forests located at strategic points in the South will be needed to adequately provide for future long time needs. Most of these experimental forests could only be obtained by purchase of suitable areas in blocks of from 3,000 to 10,000 acres each. Principal soil and forest types would be represented as well as each major forest district. Such a system of 17 experimental forests would comprise an aggregate area of around 100,000 acres, which could probably be acquired at the present time at an average price of about $7.00 per acre. The acquisition and development of these experimental forests would fulfill one of the most urgent forest research needs in the South.

During the past year it has not been practicable to investigate fully the possibilities of finding suitable experimental forests on the Ouachita, Kisatchie, and Homochitto National Forests, although preliminary extensive surveys have been made with this in mind. One of the important jobs ahead is tentatively to select experimental forests suitable to our future needs and make definite recommendations for their acquisition. The present time seems to be exceptionally favorable for acquiring suitable areas at reasonable cost.

Olustee Experimental Forest

A considerable part of the Station's efforts during 1932 went into the development of the Olustee Experimental Forest, on the Osceola National Forest, near Lake City, Florida. It is planned to center many of the Station's turpentining investigations on this Forest, to supplant the work which has been under way at the Starke, Florida, branch since 1923. Most of the work at Starke was discontinued December 31, 1932, when the Starke and Lake City offices were consolidated.

The Olustee Experimental Forest comprises a total of 620 acres situated about 10 miles east of Lake City, Florida, on the Osceola National Forest and adjacent to the main highway leading to Jacksonville. Ten acres were turned over to the Bureau of Chemistry and Soils in August, 1931, to be used as a location for an experimental naval stores station where a number of buildings have been erected and equipment installed to study the problems of distilling and using naval stores. It is planned to increase the 620-acre area which is now in two blocks (332 and 288 acres, respectively), eventually rounding out this experimental forest to about 2,500 acres.

A 25 per cent cruise of the timber in the 620 acres was made in 1931 and the area divided into 10-acre compartments. A forest type map was prepared, which showed the following areas in different types:

Cover type	Area in Acres	Per cent of total
Longleaf pine	323	52
Slash pine	112	18
Slash pine-cypress	19	3
Longleaf pine-oak	11	2
Open (Originally longleaf)	155	25
Total	620	100

In April, 1932, a soil map was prepared, by a soil surveyor assigned by the Bureau of Chemistry and Soils. A close correlation between soil and forest cover type was found. A summary of the soil types and relative proportion of the total area which each occupies, arranged according to degree of drainage, is as follows:

Well drained (longleaf)	
Leon fine sand (with hardpan)	21 per cent
Blanton fine sand	2 " "
Moderately drained(longleaf)	
Leon fine sand (friable brown horizon)	37 per cent
Poorly drained (slash predominating)	
Plummer fine sand	24 per cent
Portsmouth fine sand	7 " "
" " " (shallow phase)	1 " "
" loam	less than 1/2 per cent
Muck (organic soil)	8 per cent
TOTAL	100 per cent

The road and fire line development work was practically completed in 1932. The fire-line roads were laid out to cut the area into 10 to 20-acre blocks. Where possible the fire-breaks were cut along compartment lines and fire-lines were constructed around most of the ponds and swamps. The fire-break system is made up of 3 classes of lines: (1) graded roads 14 to 20 ft. wide; (2) motorways, 8 to 10 ft. cleared lines suitable for motor travel; and (3) 8 ft. fire lines, not open to motor travel during wet weather. The experimental forest areas are further protected against fires coming in from the outside by a 30 ft. fire-break around each of the 2 blocks. Completion of the road and fire-line development work was made possible by a $2,500 emergency allotment in 1932.

In the spring of 1932, both blocks of the experimental forest were enclosed with a hog-proof wire fence, a total of 8 1/4 miles, at a cost of $245.00 per mile.

An emergency fund allotment of $10,700 has been made to construct a set of headquarters buildings on the Olustee Experimental Forest, and detailed plans have been drawn up with the idea of completing this work before July 1st, 1933. This development work will include the construction of a ranger's residence, a small office, a field laboratory, a greenhouse, a storage shed, and a work-shop. A water and sewerage system, electric light plant, and telephone service are planned in connection with the buildings.

The experimental work undertaken on or near by the Olustee Experimental Forest to date includes the establishment of 42 permanent plots (22 thinning plots, 15 reproduction plots, and 5 fire study plots). It is planned to establish several additional plots during 1933, particularly in connection with the fire and gum yield projects. Continuous records of air temperature, humidity, and rainfall on the Experimental Forest have been kept since August, 1932.

Natural Areas

During 1932, a formal report was prepared recommending the setting aside of 800 acres of virgin longleaf pine, typical of the deep sand type, on the Choctawhatchee National Forest in western Florida, to serve as a natural area. It was recommended that no cutting, turpentining, or development work of any kind be done on this area, in order that it might serve as a permanent example of virgin growth of longleaf pine, with its characteristic animal and plant life and soil conditions. The setting aside of natural areas on other National Forests in the South will be recommended as rapidly as suitable areas can be selected, in cooperation with the administrative forces.

CURRENT INVESTIGATIONS

Fire

Fires occur so commonly in the forests of the South that information as to their effect on timber growing is of great importance. Many of the Station's projects involve the factor of fire, but only those concerned with fire damage are carried under the fire study project.

Information on fire damage is being obtained in part from established plots in second-growth southern pine stands, burned over at different seasons of the year annually or periodically and compared with unburned check plots. Detailed records of tree growth are taken at 5-year intervals. During 1932 the second 5-year remeasurements were made on the 15 loblolly pine fire plots at Urania and the first 5-year remeasurements of the 5 longleaf plots at McNeill.

During 1932 four additional fire studies were initiated to determine the damage done by accidental fires occurring under the following conditions:

(1) September (1932) fire in a stand of longleaf and loblolly pines ranging from seedlings to seed trees, on an area unburned for 17 years (Urania).

(2) March (1932) fire in 7 and 8-year old slash pine plantations, unburned for 8 years (Bogalusa).

(3) March (1932) fire in 8-year old loblolly pine plantation, unburned for 8 years (Bogalusa).

(4) July (1932) fire in 12-year old stand of natural reproduction of longleaf pine unburned for 12 years (Bogalusa).

All available data on fire are being assembled into a manuscript on "Forest Fires in the South," the first draft of which has been completed. It is realized that a great amount of additional information on fire relationships will be needed before any statement on fire in the South can be considered adequate. The present manuscript will be more of a progress report than a final publication on the subject.

Because of the growing need for a definite statement of the Station's position on the relation of fire to the growing of pine timber in the South, a brief summary was drawn up in the form of a mimeographed circular, dated June 21, 1932, and was given limited distribution, particularly to foresters in the South. This statement represented the best present knowledge and studied opinion of the Station Staff. Because of the general demand for information on this subject and the general interest in the Station's views, the 23 points contained in the previous statement are reproduced here, with relatively few changes. Some phases of the subject are not touched upon, such as the influence of fire on soil fertility and soil erosion, the relation of fire to beef cattle production or to game production, or the influence of fire on forage plants and range grasses. The importance of these phases is recognized, but they are either outside the scope of the Station, or are awaiting further investigation before any statement can be made.

FIRE STATEMENT

1. No general statement on forest fire can be made that is uniformly applicable to all parts of the southern pine region. The solution of the fire problem and the desirability of using fire for specific silvicultural and forest management purposes will differ with individual tracts, and will vary with tree species, size of trees, density of stand, quantity of combustible material present, weather, and other factors. No single set of recommendations can fit all conditions.

2. Forest areas that have never been burned over are exceedingly rare in the South at the present time. Fires caused by lightning have occurred from an indefinitely remote time in the past; the Indians are known to have burned the woods for various purposes; and since settlement by the whites took place forest and grass fires have occurred throughout the southern pine region annually or at irregular intervals.

3. Fire has caused great damage to southern pine forests.

4. Where forestry is to be successfully practiced, uncontrolled fires cannot be tolerated. Control of fire is essential to any forestry project in the South. It can be most economically obtained through organized fire protection.

5. "Forest fires," as the term is used here, applies to fires that burn over forest land excepting controlled fires used by the owner for silvicultural or forest management purposes. Controlled burning is burning that is carefully carried out, according to a prearranged plan, for specific silvicultural and forest management purposes, under favorable weather conditions and with help and equipment adequate to insure confining the fire to the area that it is proposed to burn.

6. Although the greater part of the South was originally covered with forests, most of which have now been cut, much of the land formerly forested is marginal or submarginal for timber-growing purposes at the present time, because of heavy brush, low productivity of the soil, or other conditions. In this discussion, land is considered as forest land if it gives promise of profit either (1) through forest crops alone (the possibility of such profit depends on the present or potential forest

stand, the productivity of the soil, and various economic consideration), or (2) through forest crops together with correlated uses such as hunting and recreation or the conservation of soil and water. In forest fire protection activities in the South, priority should be given to areas that have favorable possibilities for profitable forest production and on which the owners desire a second growth of timber. Whether or not the expense of fire protection is justified in a given case must be decided according to the objectives. In judging the profitableness of each forest project the area involved must be considered as a whole.

7. Under normal weather conditions fires during the late spring, summer, and fall months are much more damaging to forest growth than those during the winter, or dormant season.

8. Fires on land protected for a number of years and having a dense understory of reproduction or brush may be very damaging to southern pines of all species and sizes, especially if they occur during dry periods at any season of the year. Particularly severe damage results from fires occurring on peat or muck soils in dried-out swamps or ponds.

9. Longleaf pine differs greatly from the other principal southern pines (slash, loblolly, and shortleaf) in its habits of seeding and growth, but particularly in its resistance to fire. It is the most fire-resistant of all species of southern pines.

10. For longleaf seedlings the period of greatest susceptibility to fire is the period immediately following germination, in the fall or early winter; the seedlings cannot survive if touched by fire while in the cotyledon stage. Some seedlings on areas burned over survive the fire because of being favorably located, as on bare spots or behind logs, or because the fire does not burn over 100 per cent of the area. After their first growing season, a considerable proportion of longleaf seedlings can survive annual or periodic winter fires. Because longleaf pine produces seed crops much less frequently than shortleaf, loblolly, or slash pine, a fire on an area stocked with newly-germinated longleaf seedlings may delay natural reforestation for a much longer period than if the area had been occupied by a seedling stand of any of those species.

11. Growth of longleaf seedlings is retarded by annual winter fires, the degree of retardation depending on the quality of the site and the degree of defoliation. (If fire is kept out for several years, excessive competition by other forms of vegetation or severe infection by the brown-spot needle disease may have a retarding effect on longleaf seedling development.)

12. Where annual or periodic winter fires occur on slash and loblolly pine areas they kill a large proportion of the pine seedlings. Shortleaf pine seedlings subjected to fire are killed back to the ground; some of them sprout, however, particularly those between one and eight feet in height.

13. After they reach sapling size, southern pines apparently can be subjected to controlled fire with very little mortality, except where the undergrowth or ground cover is dense or high.

14. Fire causes particularly severe damage in stands being turpentined where the trees have not been carefully protected by raking and in stands that have been worked out and abandoned for turpentining.

15. Mature pine stands may be injured by fire-scarring as a result of repeated fires, and by loss of entire trees through the cumulative effect of repeated fires and contributing factors (insects, disease, drought, wind, etc.).

16. Fire may be used advantageously for specific purposes in the management of southern pine stands, particularly in the longleaf region, but only under the control and direction of men skilled and experienced in such practice. Such specific purposes include firebreak construction and the removal of excess fire hazard, and other forest management purposes discussed in the following paragraphs. The benefits of controlled burning must be weighed against the costs, and against the damage done to the timber, particularly if the fire gets beyond control.

17. It is customary in naval stores operations to rake around each turpentined tree and burn off the accumulated litter and grasses annually, to insure against accidental fires at other times when fire might have disastrous effects. The protective effect of any single fire does not last much beyond the growing season immediately succeeding the fire, particularly where grass forms the bulk of the fuel. Although such use of fire for protective purposes is advisable where adequate fire protection cannot otherwise be obtained, it may have a detrimental effect on gum yields.

18. Under complete protection of forest stands against fire, the accumulation of litter and ground cover, and hence the fire hazard, increases gradually up to 5 or 10 years. If underbrush is present the fire hazard may increase even beyond 10 years.

19. The fire hazard is reduced by cattle grazing in proportion to the quantity of forage removed. Open range grazing, which is common practice in the South, reduces the fire hazard relatively little, whereas pasture grazing to maximum capacity is beneficial as a fire protection measure.

20. Timber owners who combine cattle grazing with timber production and who burn over a part of their range annually or periodically with the purpose of removing accumulated dead grass and keeping down underbrush will cause more damage to their timber than is necessarily entailed by this burning unless they follow the practice described in section 5 and unless they suspend the burning during the period of years required by the trees to become established. The cattleman's practice of burning at will lands belonging to others who desire to grow a second crop of timber cannot be too strongly condemned.

21. Burning in advance of a heavy longleaf seed-fall over an extensive area assists in obtaining a heavier initial stand of reproduction. Under many conditions the other pine species are better able than longleaf to establish themselves on unburned land. (Many factors influence the survival of pine seedlings; good germination does not assure satisfactory survival.)

22. Winter fires over extensive longleaf pine seedling areas reduce the brown-spot needle disease (Septoria acicola) infection for one season and often to a lesser degree for a second season. This disease seldom seriously affects the development of longleaf seedlings after they reach a height of two feet. It is negligible on the other southern pines and in many localities is not serious on longleaf.

23. The growing of successive crops of longleaf and other southern pines on a commercial basis requires mastery of the whole fire situation, and to that end organized fire control is recommended. No single set of specific recommendations will fit all conditions. Details on fire protection or the silvicultural use of fire must be carefully worked out for individual tracts, with due weight given to such factors as species and size of trees, density of stand, the quantity of combustible material present, and the costs involved. Use of fire in the silviculture and management of southern pine forests requires judgment and a knowledge of when and how to burn for specific purposes. Ill-advised use of fire may result in great damage to the timber and serious loss to the timber owner.

* * * * * * * * * * *

Many of the above 23 points are concerned with other factors than fire alone and are tied in closely with forest management and silvicultural problems. The results of the Station's investigations in a number of fields will be made use of in the final analysis of the whole fire problem in the South. Plans are under way to go more thoroughly into the controlled burning problem, both for silvicultural as well as for protection purposes. It is planned to try out controlled burning during the winter of 1932-33 in longleaf and loblolly stands, near Urania, La., and near Lake City, Fla., where a section (18) of longleaf land on the Osceola National Forest has been reserved for that purpose. Efforts will be centered on putting the fire bulletin manuscript into shape for publication as soon as possible.

MANAGEMENT

The investigations in management have to do with methods of growing timber crops, the foundation on which all forestry rests. The aim is to develop a technique for reproducing and managing forests that will assure optimum yields of all forest crops and byproducts. These investigations include studies of natural reproduction, thinning and stand betterment, and cutting methods.

a. (Natural Reproduction)

Studies of longleaf pine reproduction are being continued at Bogalusa, La., and at McNeill, Miss., and the development of stands is being followed from year to year on numerous small plots representing many different growing conditions. At Bogalusa the effects of fires of different kinds and at different intervals on reproduction are being observed. At McNeill study of the effect of grazing and annual fires is being carried forward in cooperation with the Bureaus of Animal and Plant Industry and the State of Mississippi. At both places some work has been done to determine the fundamental physical or ecological factors underlying the different behavior of tree seedlings. Though all of these are necessarily long term projects, they yield definite, useful information as the work progresses. For instance, during the past year it has been shown clearly that the customary method of age determination of seedlings is entirely unreliable for longleaf pines in the "grass stage" (less than six inches high). This means that for longleaf pine the rate and manner of development of the seedlings can be learned only by careful and continued observation of permanent sample plots over a period of years.

At Bogalusa intensive studies are being made of some of the most important factors in growth rates of longleaf pine seedlings. The principal factors receiving separate attention are brown spot disease, density of seedlings, and grass competition.

Other studies of longleaf pine reproduction are being conducted at Urania, La., Camp Pinchot, Fla., and Lake City, Fla. Studies of shortleaf and loblolly pine reproduction are centered at Urania, La.

b. (Methods of Cutting)

The best means of obtaining natural reproduction of longleaf pine on deep sandy soils by different methods of cutting is being studied at Camp Pinchot in western Florida. The establishment of one series of permanent plots, begun in 1931, was completed during 1932. This series of six plots represents the three conditions of longleaf stands on the Choctawhatchee National Forest to which a standard seed tree method might be applied. These three conditions are as follows: (1) unturpentined (all trees round); (2) trees over 10 inches d.b.h. turpentined with one face; and (3) trees over 10 inches d.b.h. turpentined with two faces. In each cutting, six trees per acre on the plot marked for cutting were left for seed, the three check plots remaining uncut.

Another series of six 10 acre plots originally marked in 1930, were finally cut during 1932. This series represents a uniform virgin longleaf pine stand cut by different silvicultural methods with varying numbers of seed trees and methods of their distribution. The total area of all cutting plots at the Camp Pinchot branch is 118 acres, 58 acres of which are under intensive observation.

No other methods-of-cutting plots were established by the Station during 1932. During 1933, however, it is planned to establish additional plots of this nature near Urania, La., and Wilmar, Ark., in mature shortleaf and loblolly pine stands.

Increment borings were taken from each of the 244 longleaf pine seed trees remaining on two blocks of the "200-acre tract" near Bogalusa, La. This tract was cut over in 1923 and the residual trees when examined in 1932, were putting on their tenth annual ring since cutting took place. The nine complete growth rings made since cutting were measured and a fairly accurate estimate of growth in diameter for the full 10-year period was obtained. The following data on accelerated growth after cutting were secured (all diameters and diameter growths are at breast-height): The trees, ranging from 7 to 17 inches in diameter at the time of cutting averaged from 0.63 to 1.29 inches in diameter growth during the 10 years before cutting and from 1.56 to 1.77 inches in the 10 years after cutting. Before cutting, the average growth was greater with increase of diameter, but after cutting the average growth was slightly less for the larger than for the smaller trees. Calculated as a percentage increase over the 10 years before cutting, the diameter growth after cutting ranged from a 21 percent increase for 15 to 17-inch trees to a 181 percent increase for 7 and 8-inch trees. That is, the smaller trees accelerated slightly more in absolute diameter growth and very much more in relative increase in diameter growth than the larger trees. There was no marked increase in growth rate until about the third year after cutting, when the growth took a sudden spurt and held up well over the following six years.

Annual observations are being made in a number of second-growth and residual pine stands at a number of points throughout the South to determine the size and other characteristics of good seed trees. The cone crop on each of hundreds of numbered and described trees is counted annually. These cone counts will supply general information on periodicity of seeding and variability in cone production for the same trees over a period of years.

c. (Thinning)

The Station has now a total of 23 series of thinning plots in second-growth southern pine stands. These include 73 plots, of which 25 are check plots (untreated) and 48 thinned. Each of the four principal southern pines and a variety of sites, age classes, and methods and degrees of thinning are represented. There is practically no limit to the scope of a program of experimental thinnings if all age classes, sites, and methods and degrees of thinnings are to be represented for each of the four major species of southern pine. It is possible, however, that the effects and relationships of the numerous variables on unmatched plots may be studied by the statistical method of multiple correlations. This method, if applicable, would require only a moderate (and definite) number of plots and its use might make it possible for the Station within a comparatively short period of years to establish the thinning plots needed to give reliable and complete results. During 1933 the thinning data now on hand will be analyzed in order to determine the applicability of the method of multiple correlation. If the method proves satisfactory, future plots will be established with this type of analysis in view.

Twenty-two thinning plots were established at the Lake City, Fla., center of work during February, 1932. Ten of these plots were located on the Osceola National Forest and twelve on the Olustee Experimental Forest. Of these 22 plots, eight were reserved as checks, while the number of trees left on the thinned plots included the following spacings: 100, 150, 200, 250, 300, and 400 trees per acre. The following are given as samples of the marking rules:

1. 200 trees per acre: the 15-8 rule.
2. 300 trees per acre: the 12-6 rule.
3. 400 trees per acre: the 10-5 rule.

An example will make clear the application of the marking rules. For 200 trees per acre an average spacing of 15 feet (on three sides) was maintained with the exception that no two trees could be closer than 8 feet. Exception from these rules should be made when thinning is done in 25-year-old or older stands in which some of the trees are of sufficient size for turpentining. Thus, if a 7-inch tree comes within the scope of the above rule but the tree has a good crown it should be left as it will be ready for turpentining in a few years.

The Station can plan, with full assurance of permanency, long-time experiments on the experimental forest. Trees can be grown under varying conditions to turpentining size and then turpentined under various systems of management designed to obtain maximum continuous production of naval stores and other forest products.

Records were obtained by the Station from large-scale thinnings conducted on the Osceola National Forest near Lake City, Florida. From about 3,500 longleaf pines cut from 25 to 35-year-old stands, it was determined that it requires about 50 per cent more time to fell a 35-year-old tree than to fell a 25-year-old tree of the same size. It was also found that the time taken to fell trees of a given diameter is independent of the density of the stand. Labor costs in 25-year-old stands varied from 10 cents to 68 cents per acre as the number of trees removed varied from about 200 to 1,000 per acre, with wages $1.00 per day. Chopping time per tree varied from one second for one and two-inch trees to about 40 seconds for six-inch trees.

Results from a half-acre thinning plot near Starke showed that turpentining on most of the trees designated for removal with the usual French or American face methods was decidedly unprofitable because of the low yields, large amount of dry face and high tree mortality. Fair yields were indicated, however, for the best trees of the "removed stand", especially trees of the codominant and dominant crown classes.

In addition to the studies of the effect of thinning on the future development and gum yields of stands, a study was made of the cost and practicability of thinning. During a large scale thinning made on the Osceola National Forest in early 1932 methods of marking and chopping supervision were investigated. It was found that the cheapest and most practical method consisted of using a foreman with a crew of five or more choppers, depending on the density of the stand, in which some of the choppers worked slightly in advance of the foreman cutting conservatively and leaving all doubtful trees to be marked and cut by the foreman with the help of one or more choppers. Marking trees in advance of any cutting was costly, and it was difficult to obtain a uniform thinning. The task of marking is made much easier if cutting takes place simultaneously by reason of the fact that many trees come out as a matter of routine and once they are out the marking of the remainder is made much easier.

Three large scale improvement thinnings in second-growth longleaf pine were made on the Olustee Experimental Forest in February, 1932. Each thinning covered a 10-acre compartment. The purpose was to try out under semi-commercial conditions the application and practicability of marking rules developed on small experimental thinning plots.

No additional thinning plots were established in slash, loblolly, or shortleaf pines during 1932. It is planned to establish several new loblolly pine thinning plots at Urania and slash pine thinning plots in southern Georgia early in 1933. Further experimental thinnings in the southern pines will be delayed somewhat until the method of analysis by multiple correlation has been tested, since the technique of establishment will be changed in several instances if the new method is adopted.

A large lumber company near Bogalusa, La., has a considerable acreage of slash pine plantations that will need thinning within the next two years, and considerable loblolly and longleaf that will need thinning within about five years. The Company intends to make thinnings in these stands and has invited the Station to cooperate in establishing large-scale experiments to determine the best methods. The Station will make a working plan for this study during the coming year.

A number of thinning plots and commercial thinnings made by several lumber companies and land companies were visited during 1932, making possible a valuable interchange of ideas between these companies and the Station. The Station will cooperate in maintaining, remeasuring, and analyzing the results from a series of three thinning plots established by a large lumber company in 1928 in a 25-year-old stand of loblolly pine near Franklinton, southeast Louisiana. Two of these plots were given different degrees of French (crown) thinnings; the remaining plot is untreated as a check.

FORESTATION

In forestation the principal progress to record is in the preparation of the forestation bulletin, which has been under way for about five years. The rough draft of the section of the bulletin dealing with seed has been completed; preparation of the text dealing with nursery practice and planting is going forward rapidly, and the entire draft is expected to be completed by March 1933.

The progress of the forestation studies is emphasized in another way by the fact that the Station's oldest experimental plantations, four one-acre squares of loblolly pine planted at different spacings, have completed their tenth growing season in the field. In 1925 it was thought these plantations would have to be abandoned because of tip moth injury, and in the spring of 1926 the largest tree was only 57 inches high. Now many of the trees, especially in the densest (5 x 5 ft. spacing) plantation, have recovered remarkably from tip moth attack, the top of the general crown canopy is 20 to 25 ft. above the ground, and the lower branches have died up to a point 4 to 8 ft. above ground, depending on the spacing. Remeasurement of these plantations is the principal routine plantation job scheduled for the spring of 1933.

The summarizing and evaluating of data for use in the forestation bulletin, and the general development of forest planting in the Station territory, have greatly changed and clarified our ideas on forestation studies. A revision of the forestation filing scheme has brought out the interrelationships of apparently independent studies, and also shown which studies have the most intimate connection with new and pressing problems encountered by

State and private agencies engaged in planting. The necessity of preparing for the Copeland Resolution Report a summary of planting already done and of future planting requirements has clarified our understanding of the situation in the Station's territory as a whole.

Briefly, analysis of the Station's studies shows two distinct types of research problems in forestation:

a. Short time studies, requiring, once the proper technique is available, from one to three or four years for solution, with an equal or slightly less time for confirmation of results. Examples are methods of seed cleaning and extraction, determination of quality and quantity of seed, proper density of seedlings in the seed bed, depth of covering in the nursery, need for shade over seed beds, suitable tool to use for planting, preparation of site to insure high survival, and optimum grade (size, and stage of development) of stock to plant.

b. Long-time studies, usually made in the plantations but sometimes involving the seed used. Such studies require five to ten years at least to complete, and may require more than a full rotation of the tree species being tested. These long-time studies necessitate far better foresight and more imaginative planning than the short-time studies, a much more elaborate approach, different administration, and more background of management and basic sciences. Examples are studies of effect of source of seed on growth and development of the stand, cumulative effect of nursery management on nursery soil fertility, choice of species for region and site, effect of site on growth, effect of spacing on development of the stand (and incidentally on profits), effects of mixtures of species, and feasibility of pruning.

From material recently gathered it is evident that only a minute portion (perhaps 1 percent or 2 percent) of the area in the Southern States in need of artificial forestation has been planted, and that the whole program of planting involves, principally, lands formerly in longleaf pine. A few big companies have taken the lead in planting; approximately 64 per cent of the 61,750 acres reforested artificially in the Station's territory have been planted by four lumber and paper companies, and the remaining 36 percent by several smaller companies, some 1,200 farmers, eight State forestry departments, and the Federal Government.

General observation and experience show:

a. A great and increasingly popularity of slash pine for planting, even beyond its natural range and off its usual sites. Slash pine has done well under the new conditions and remained remarkably free from injury, but the indiscriminate establishment of large, pure, even-aged plantations of an untried species is disturbing on theoretical grounds. We have already seen what the Nantucket tip moth does to similar indiscriminate plantations of loblolly pine.

b. A frequent yielding to expediency in nursery management, with fairly satisfactory results in most seasons but occasional conspicuous difficulties unduly reflected in the cost of planting and prejudicial to artificial forestation in general. The almost universal failure to fertilize or use soil building crops is a case in point. It should be emphasized, however, that the details of nursery practice are usually peculiar to the ground on which the nursery in question is situated; nursery problems lend themselves less readily to centralized research than do problems involving plantations or seed.

c. Ability on the part of the important planting agencies to carry out most of their own more elementary short-time studies in forestation, not always in the most economical and efficient way, but effectively enough to insure good survival of planted trees at reasonable cost and to advance our knowledge along many lines, both theoretical and applied.

d. A tendency of these same important agencies to call on the Station when they encounter problems of greater technical difficulty. These calls are not limited to the fields in which the Station has conducted experiments, but include questions of nursery soil depletion, injurious insects, and other lines in which the Station has done no work.

e. A tendency of most agencies engaged in planting to stress the short time studies, which yield what they call "practical" results, to be satisfied, at first, with good initial survival; and to overlook almost entirely the long-time studies. It seems to rest with the Station, and logically so, to carry out long-time studies and to call attention of other agencies to them and to emphasize their importance.

The future forestation program for the Station involves:

1. Completion of the manuscript of the forestation bulletin with all possible speed.

2. Preparation of a number of more detailed technical articles, after completing the bulletin, to make available the miscellaneous results of forestation studies to date.

3. Closing out several forestation subprojects or parts of subprojects too local in their bearing to warrant further expenditure; 1 and 2 above will aid in completing this work effectively.

4. Postponing further detailed nursery experiments until Region 7 establishes a nursery in connection with the Kisatchie Forest; in this way the Station can simultaneously assist the Region in solving its local short-time problems and lay the foundation for a few carefully-selected long-time studies having a bearing throughout the Station territory.

5. Devising a scheme for assisting planting agencies in solving their own local short-time problems by cooperating with them in the establishment of simple tests; many nursery problems and a number of planting problems could be handled in this way, by a mimeographed outline of methods, supplemented by correspondence and visits.

6. Undertaking a thorough study of effect and importance of seed source.

7. Improving germination test technique.

8. In future planting experiments concentrating efforts on spacing, mixture of species, choice of species for site, conversion of brush fields to productive plantations, and other long-time studies.

MEASUREMENTS

Southern Pines

Volume and yield tables for the four principal species of southern pines have been available since 1930 (U.S.D.A.Misc. Publication No. 50 and U.S.D.A. Circular No. 124). These tables apply primarily to normal or fully-stocked, even-aged second-growth stands, and their application to understocked or to uneven-aged stands, such as predominate throughout the South, is not yet fully understood. There is great need for a better understanding of how understocked second-growth pine stands grow or develop over a period of years so that accurate growth predictions may be made. It is planned to obtain some of this information through the establishment of permanent growth plots in understocked stands of varying densities. One such plot was established during the past year in an understocked stand of loblolly pine near Urania, Louisiana. The stand averages 24 years old and the stocking is about 85 percent of normal. This makes a total of five growth plots established by the Station in understocked stands of southern pine. It is planned to increase this number as rapidly as available funds and personnel will permit. An effort will be made to establish a few such plots each year.

Permanent plots to determine the rate of growth in fully-stocked second-growth stands, as distinct from the understocked stands mentioned above, have been established separately or are available in the various thinning, management and fire studies where the check plots are left undisturbed. At present the Station has 37 such plots in stands of various ages, fairly evenly distributed among the four principal southern pines. Additional check plots for other studies will increase this number from year to year. Occasionally it is advisable to establish a growth plot in a mature or almost mature fully-stocked stand to study the balance between mortality and growth. One new plot of this nature was established during 1932 in a 64-year-old stand of loblolly and short-leaf pine near Urania, Louisiana.

BOTTOMLAND HARDWOODS

During 1932 progress on the red gum growth and yield study included the establishment of 68 semi-permanent growth and yield plots in fully stocked second-growth stands. These plots are located in northern Louisiana, southeastern Arkansas, and northwestern Mississippi. For the most part, they were established in stands found on areas that were formerly under cultivation, as abandonment of agricultural land at various times in the last 75 years has resulted in a considerable area of more or less even-aged red gum second-growth timber.

Volume table measurements for the preparation of red gum volume tables have been made on 79 red gum trees 16 inches or less in diameter.

Although at certain times of the year many portions of the Mississippi Delta region are very wet, fires are not uncommon in the dry season. Consequently almost all second-growth red gum stands show evidences of fire damage. In order to ascertain the amount and extent of such damage, one permanent growth and fire-damage plot was established in an even-aged, fully stocked red gum stand approximately 21 years old. Further examinations will show the extent of decay following the fire wounding, and the occurrence of mortality in fire-damaged stands of approximately this age.

In order to test the presumption that growth rates in understocked second-growth red gum stands of given age are greater than in similar fully stocked stands, one permanent yield plot was established in an understocked red gum stand approximately 16 years of age. Future reexaminations and comparisons with rates of growth on the semi-permanent yield plots of comparable age should furnish a basis for comparison of the growth of red gum in fully stocked and understocked stands.

It is expected to complete the red gum growth and yield study in 1933, after which plans will be made to extend the hardwood growth investigations to other principal hardwood species or groups of species.

NAVAL STORES

a. General

The end of the 1932 chipping season marked the closing out of most of the work at Starke, Fla., preparatory to centering the Station's future naval stores investigations at Lake City and Olustee, Florida. It completed a 10-year period during which the Station has had a branch at Starke and rounded out a number of investigations in naval stores practice, resulting in the development of improved turpentining practices. By application of these new methods timber owners and operators in the naval stores belt are assured of increased yields, reduced costs, and of doing less harm to their timber.

The Station's first major publication on naval stores, "Experiments in Naval Stores Practice" appeared in April, 1932 (U.S. Department of Agriculture Technical Bulletin 298). This bulletin embodies the results of the Station's first 5 years investigations (1923-1927) on gum yields and chipping methods. A second manuscript dealing with the results of all other tests is well along and will complete the report of the Starke naval stores chipping methods and yields experiments to date. This manuscript will be submitted in 1933.

A severe drought which occurred in the region around Starke between August, 1931, and May, 1932, resulted in the death of many turpentined trees. The effects of the drought were augmented by devastating fires and severe attacks of Ips bark beetles. Severe damage was done to some of the Station's experimental plots, particularly to the slash pine timber at Sampson Lake.

A study of the suitability of wooden cups for holding crude gum was started, in cooperation with the Forest Products Laboratory. Cups of several shapes treated with several coating materials were set out and appear to be holding up well under weathering.

b. Gum production and methods of chipping

In the methods of chipping studies, 1/4 and 1/2-inch height of streak groups were worked for the 7th year. The 1/2-inch groups were discontinued at the end of the 1932 season. The 1/4-inch work gained on the 1/2-inch in yield and at the end of 1932 there was little to choose between these two styles of chipping in slash pine. The 1/4-inch streaks on longleaf, although they showed up somewhat better in 1932 than in previous years, still failed to yield as much gum as wider streaks. However, the extra years of work possible puts the total yield from a face chipped 1/4-inch ahead of the 1/2 and 3/4-inch chipping.

The interval of chipping study was continued throughout the winter of 1931-32 and until the end of the 1932 season. Some changes have taken place in the yields for the second year of work. The trees chipped 6 times a week have dropped from approximately three times the yield of the check trees (once a week chipping) to approximately 2.4 times. The trees chipped three times a week have increased from 2.5 to 2.7 times the yield from the once a week chipping, while the twice a week chipped trees have yielded about the same as for the previous season -- approximately 1.9 as much as the once a week chipping. The most significant change that has taken place in the second year of work is that the daily chipped trees yielded less than the three times a week chipping. The total yield for the second season dropped below the first season in all the frequencies of chipping groups, the greatest drop taking place in the daily chipping. The daily chipping trees are showing the strain of frequent chipping by dry-facing, though the drought during the past year must have played a considerable part in this. Dry-facing is found in all the groups but by far the largest proportion of dry-faced trees is in the daily chipped group, indicating the influence of the frequent chipping. Ips beetles have played a part in some of the dry-facing and the death of four of the trees -- all in the daily chipped group -- may be attributed directly to the attack of Ips beetles after the vitality of the trees has been lowered by the frequent chipping. Inspection of all the trees in midsummer showed 60 per cent of the daily chipped trees dry-faced, 40 percent of those chipped 3 times a week, 17 percent of the twice a week chipping, and no dry-face in the weekly chipped trees.

Various methods of raising cups and tins were tried out in the spring of 1932. Some of these styles influence gum yields while others have an effect on scrape formation. Although the data from this test have not been fully analyzed, dip yields alone for 23 streaks show the jump streak with saw-tooth aprons driven either in the jump streak or the face gave the best yields, next come the Ball system of gutter and apron inserted in Pringle gutter axe cuts and gutters tacked on streaks. Considerably under these in yield came the group with tins inserted in broad axe cuts and far below came the group with unraised tins.

It is planned to continue the following tests at Starke through the 1933 season: 1/4-inch height of streak on longleaf and slash, 8th year, 271 trees; methods of raising tins, 3d year, 296 longleaf; yield from back-faced trees, 260 slash. A new test to determine the effect on yield of facing trees a year before actual chipping is started will be initiated on 290 longleaf and slash in 1933. Half the trees will be given streaks in 1933; all the trees will be worked in 1934.

c. Weather and gum yield

Substantial progress was made on the manuscript "The Effect of Weather Factors on Gum Yield." The results of the work on this project show clearly the advantage of chipping trees on days favorable for gum flow. On days of high temperature a good flow of gum was obtained on the first day following chipping whereas on cool rainy days a much smaller amount of gum was obtained for the first day. The first day is by far the most important one so far as total gum yield is concerned, for the yields on the second and succeeding days after chipping vary but slightly with changes in weather conditions, whereas gum yields on the first day vary widely. The results indicate that it is good practice for operators to encourage their chippers to "lay off" on cool rainy days instead of requiring them to follow a systematic schedule of chipping every day from about Tuesday to Friday, as is customary. An elastic chipping schedule in which as little chipping as possible takes place on rainy days should increase the season's yield per streak. Practical application of some of the results of this study will be made on the Osceola National Forest in 1933.

No extensive field work was done in the weather and gum yield test during 1932. One tree at Kingsley Lake near Starke was chipped all season and the yield recorded continuously on a gum gage. This tree was enclosed in a shelter with a celophane screen top to admit light. A dendrograph (for measuring variation in tree growth) was attached above the face on this tree to determine the relation between tree diameter changes and rate of gum flow. On a few occasions the shelter was iced to reduce the temperature of the face without altering the temperature of the ground or the air temperature at the crown of the tree. This lowering of face temperature reduced the rate of gum flow by about 25 percent indicating that reduced yields are caused in part by the physical effect of lower temperature. Nearly all of the difference came during the first 24-36 hours after chipping.

d. Fire and gum yields

Additional studies of soils from burned and unburned areas showed slight difference in the chemical composition of the soils from such areas. In general, there appears to be no consistent differences in the content of total nitrogen and organic matter in soils of burned and unburned areas. Soils from burned areas, however, have a higher replaceable calcium content and are consistently less acid than soils from unburned areas. Certain improvements in technique of soil sampling were worked out in this phase of the investigation. Following established practices in other regions composite soil samples were first collected from the various study areas. Variable results were shown by the chemical analyses, but from these it was possible to determine the number of samples necessary to give significant results. The study has shown that the differences in the total nitrogen content and organic matter content as determined by standard laboratory methods are very small. To obtain significant differences it is necessary to analyze as many as 100 samples from each study area. This is now being done for selected areas. The chemical analysis work is being handled by the Florida Agricultural Experiment Station.

Litter measurements were made on a number of burned and unburned longleaf and slash pine stands in north Florida, south Georgia, Alabama, and South Carolina.

The statistical analysis of about 2000 litter measurements taken on 47 separate areas throughout the South where fire had been excluded from 1 to 50 years showed that litter depths increase up to an average maximum of 1.75 inches in 16 years of complete protection from fire. After that period of protection an equilibrium in litter depth was indicated, with decay balancing accumulation. The maximum litter depth found for any one area was 3.50 inches in a longleaf pine stand in Escambia County, Alabama, unburned for 15 years.

The most obvious effect of fire upon the soil is the removal of the forest litter. Great significance has been attached by foresters to the destruction of this natural fertilizer; but little or no experimental data showing the true value of litter have been published. Analyses show that pine litter, following its decomposition, is potentially a source of considerable quantities of nitrogen. It is not known, however, how much nitrogen enters the soil from decaying litter or how much of it passes into the atmosphere. To throw light on this question, lysimeters have been installed on the Olustee Experimental Forest where it is proposed to follow through the decay of litter of known chemical composition. This will give actual figures on the rate and nature of the decomposition of pine needle litter and an idea of its fertilizing value as compared with its removal by fire.

The gum yields obtained from the burned and unburned Raiford second-growth slash pine fire plots indicated no significant difference resulting from annual fires. These results are based upon two years of turpentining. One of the plots had been burned annually and the other protected from fire for a period of about 10 years. While this single experiment is not considered adequate to test the effect of annual burning on gum yields, it does indicate that whatever differences may exist are apt to be small. More comprehensive experiments to determine the gum yields from burned and unburned woods will be initiated on the Olustee Experimental Forest in 1933. Studies of the effect of crown scorching on gum yields will also be undertaken.

EROSION-STREAMFLOW

Investigations to determine the place of forests in erosion control and in the regulation of streamflow have been carried on by the Station since 1929. These studies are concentrated in the Loessial Silt Loam Uplands of Mississippi - a region some 6 1/2 million acres in area, where erosion is extremely serious.

Erosion surveys made of 9 northern Mississippi countries in 1930 indicate that approximately 28 per cent of the entire area is actively eroding. Much of the erosion is of a peculiarly destructive type that gives rise to deep and extensive gullying. The surveys indicate that several hundred thousand acres in the region are so badly gullied and washed that artificial methods will be needed to restore a protective cover of forest or other vegetation. The rehabilitation of these unproductive, denuded areas appears urgent from the standpoint of streamflow regulation and the protection of adjacent, arable land, but the means by which this may be accomplished involves many perplexing problems.

In order to develop the most economical and effective methods of controlling the growth of gullies and reclaiming eroded areas by planting trees and other vegetation, experimental studies were started in the spring of 1931. Six areas of about one acre each located on representative soil types in different portions of the region were planted to 9,000 nursery seedlings (1-0) of black locust, southern red oak, Nuttall's oak, loblolly, shortleaf and slash pines. Three of the areas received some preparatory treatment, i.e., had gully edges plowed in and brush dams constructed.

In the spring of 1932, additional plantings were made on areas located near Holly Springs, Mississippi, and the scope of the investigations was enlarged to include studies of soil-saving dams, methods of preparing gullies for planting, and the use of promising soil-binding vines, grasses, and other plants. Approximately 7,000 trees were planted in 1932, using shortleaf, loblolly, Austrian, and western yellow pines, black locust, Nuttall's oak, catalpa, cottonwood, and Mimosa (Albizza julibrissin). Carefully graded planting stock was used and tests were made to determine the effect of class or grade of stock and planting method on subsequent survival and growth of the trees. Nursery seedlings were used in most cases but rooted crowns and root cuttings from native black locusts were also employed. In addition to trees, vines and other plants were started in gullies and washes either as a preparatory erosion control measure or in combination with the tree plantings. These were: Kudzu bean, Japanese honeysuckle, several native leguminous vines, common lespedeza, bermuda grass, Johnson grass, Dallis grass and centipede grass. Previous to planting, the edges of certain gullies were plowed in and check dams constructed to catch and hold the outwash soils while other comparable gullies received no treatment. Several types of dams of (1) brush, (2) wire netting, and (3) bermuda grass sod were used. Straw, red cedar tops, grass sod, and vines were used to reinforce the brush and wire dams.

The planting studies are of too recent origin to yield much definite information but the data from preliminary examinations indicate the following:

(1) In the case of black locust and shortleaf pine, the use of Grade 1 nursery stock gave a higher survival and rate of growth than when smaller seedlings of the lower grade were used.

(2) For planting gullied land, 1-1 nursery transplants appear greatly superior to either the 1-0 or 2-0 nursery seedlings customarily used for planting stock in the Southern States.

(3) Shortleaf pine can be established successfully on gullied sites, formerly considered too poor to plant unless covered with top soil, by planting the trees in holes dug with spade or post-hole digger and filled with top soil. From 84 to 96 per cent of the shortleaf planted in this manner survived the adverse growing season of 1932.

(4) Black locust grown from healthy rooted sprouts of native stock grow more rapidly than those from nursery seedlings.

(5) Trees planted on uneroded bank tops between gullies have a lower mortality and a higher growth rate when such areas are plowed previous to planting.

Additional planting studies are planned for 1933. Several other more valuable hardwood species will be tested, particularly on the more favorable sites in prepared gullies. Continued studies will be made of the species already demonstrated as useful and these are aimed at developing the best possible methods of establishing the species on gullied land. The propagation of black locust from root cuttings - a method that has already given partial success - will be further investigated. Pruning studies will also be made to determine how and when this may best be done to black locust and what influence such treatment has on the growth rate.

During 1931 intensive studies were started at Holly Springs, Miss., to determine the soil and water losses from the principal classes of land in this region and to ascertain the relation of such losses to floods and stream behavior. Small study plots, 3 x 12 ft. in size, were established on the following classes of cover and land use:

(1) Cultivated land (2 plots); (2) old-field abandoned 7 years with mineral soil exposed and eroding (2 plots); (3) improved pasture (bermuda grass); (4) native grass pasture (Andropogon sp.) (2 plots); (5) 20-year-old black locust osage orange plantation on field formerly gullied; (6) scrub oak woodland typical of inferior second-growth forest; and (7) virgin oak forest with 7 years or more accumulation of duff (2 plots).

Each plot is located on a 10 per cent slope and on a similar soil and each is isolated by metal borders. The rain falling on a plot is measured as is that portion flowing off the surface. The latter, together with the eroded material, is caught in a metal tank at the lower end of each plot.

These run-off studies will be carried on until the summer of 1933 in order to obtain reliable averages of soil and run-off losses from the land classes of the region. The data have already shown pronounced differences in run-off from plots protected by a cover of vegetation and that from bared surfaces and the preliminary results are indicative of flood origins. This was demonstrated during the winter of 1931-32 when abnormally heavy rainfall (27 inches in 70 days) fell on the watershed of the Tallahatchie River in northern Mississippi and gave rise to perhaps the greatest flood in the history of that region. The data from the plots (located on the Tallahatchie watershed) show that of this 27 inches of rainfall, 62 percent ran off the surface of a cultivated corn field and reached streams immediately. With the run-off went soil at the rate of 34 tons per acre. Fifty-four percent of the total rainfall immediately flowed off the barren soil of an abandoned field. During the heavier rains, from 75 to 95 percent of the rain falling on these unprotected land classes appeared as surface flow. In contrast, of the 27 inches falling on the virgin oak forest and on the unburned native grass pasture, less than one-half of 1 percent of the rain ran off the surface and carried practically no soil with it. Only 2 percent of the rain ran off soils protected by the scrub oak cover. These data are significant in that they were secured at a time when surface run-off for the region was voluminous and was poured into the main drainages quickly enough to produce a major flood. The ability of forest and grassland to absorb practically all of such excessive rainfall indicates the important relation of proper land use to the problems pertaining to the prevention and control of floods.

A summary of the run-off records from these 11 plots for 66 rains,[1] which occurred between October 14, 1931, and November 25th, 1932, inclusive, is given in the following table:

Plot No.	Cover description	Average per cent of rainfall which ran off	Remarks
1	Mature oak forest	.38[3]	Check plot
2	Mature oak forest	1.00	Burned on 3/10/32 after 6[2] months preliminary run as a duplicate of No. 1.
3	20-year Black Locust-Osage Orange plantation	1.11	Plot wrecked and not in operation during 6 rains.
4	Scrub oak woodland	4.17	
5	Bermuda grass pasture	.80	Plot wrecked and not in operation during 11 rains.
6	Native grass cover Andropogon sp.	1.21	Burned on 3/10/32 after 6[2] months preliminary run as a duplicate of No. 7
7	Native grass cover Andropogon sp.	.36[3]	Check plot
8	Cultivated land (Corn in 1931 - Cotton in 1932	37.81	Duplicate to Plot 9 for first 7 months. Cotton rows contoured on 4/13/32
9	Cultivated land (Corn in 1931 - Cotton in 1932	42.38	Cotton rows established up and down slope on 4/13/32
10	Abandoned land (Barren)	40.79	) Duplicate plots throughout
11	" " "	34.83	) entire period

---

[1] - Total rainfall from 66 storms = 30.30 inches.

[2] - Previous to burning, the percent of run-off from Plot 2 averaged slightly less than that from Plot 1. Also run-off from Plot 6 averaged slightly less than that from Plot 7 before burning.

[3] - Average run-off per cents for Check plots 1 and 7 represent run-off from the respective types of cover for entire period.

Another project undertaken in 1932 is the measurement of run-off and eroded soil from 2 small gullies (.156 and .042 acres, respectively). The run-off discharge is passed through a settling tank to separate out the soil load and is then measured over a 90 degree triangular-notch weir. These measurements will be taken overaa 2-year period during which time data will be obtained on the growth of gullies, the soil and water losses from such areas, and the factors involved. After this preliminary run, control measures involving the use of trees and other vegetation will be applied to the gullies and an accurate measure obtained of their relative effectiveness.

The latter project has already yielded data indicating that frost action is one of the most potent factors in accelerating the growth of gullies in this region. In March, 1932, erosion measurements from one gully correlated with temperature records showed that a single light freeze followed by a moderate rain increased erosion more than 10 times over that produced by a comparable rain previous to frost action.

Financial Aspects of Private Forestry

The purpose of the Financial Aspects study is to determine for the South where and under what forest and economic conditions private forestry promises to be profitable and also where and under what conditions it is likely to prove unprofitable.

Timber inventories and growth data obtained from eleven county-wide studies, located in eight southern States and representing various pine timber types, show that timber-growing conditions are very favorable in many parts of the region. Many well-stocked stands of shortleaf and loblolly pines were found, the growth being fairly rapid in spite of periodic forest fires. Economic conditions in the shortleaf-loblolly region such as taxes, land values, and markets for forest products, are generally favorable for profitable forest management under normal conditions. Second-growth stands of slash and longleaf pine managed for naval stores also give promise for profitable forestry. On the other hand, the common practice of turpentining small trees and the annual raking and burning of turpentine orchards lessen the possibilities for forestry. Economic conditions in the longleaf region range from favorable to prohibitive for timber growing, depending almost entirely on the amount of the tax burden. In the pure longleaf type second-growth stands of good density are not generally found and private forestry there appears dependent to a large extent upon artificial reforestation or upon very different methods of management than those now practiced. Financial possibilities under these conditions are yet to be determined.

An intensive study, including a 10 per cent inventory and careful determination of growth, of several thousand acres of second-growth shortleaf-loblolly pine, which is probably a fair average for the best 10 percent of this timber type in the South yielded the following data for the forty acres which was nearest the average of the whole tract and for the forty acres which was the average for the best 25 percent of the area:

Size of Trees	Average Forty Volume per Acre [1]			Average of best 25 percent - Volume per acre		
	1932	1937	1942	1932	1937	1942
	Board Feet			Board Feet		
8" d.b.h. and over	4,591	7,342	10,579	7,559	11,107	14,944
13" d.b.h. and over	2,244	4,094	6,957	5,034	8,040	11,068
17" d.b.h. and over	115	497	1,525	636	1,875	4,836

[1] Volumes International 1/4-inch Kerf Rule, which approximates mill cut. Reduced 3.4 per cent for defect, based on local utilization.

The average stand has been more heavily cut in the upper diameters than the better stands but after five or six years the average volume of the entire tract should approximate the present volume of the better stand. Under management the annual increment of the better stand will be increased also.

The annual cost per acre of growing this stumpage included $.11 for taxes and $.07 for fire protection and administration, or a total of $.18. Although the better stand was recently cut to a 17-inch diameter limit, within a period of five years there will again be 1875 board feet in trees 17 inches and larger giving an average annual growth of about 375 board feet per acre. The cost of producing one thousand board feet of stumpage during the 5-year period is $.48. During the next 10-year period approximately 484 board feet per acre will be grown each year on the better stands, at a cost of $.37 per thousand board feet of stumpage. Interest on the investment in land and timber has not been included.

The cost per thousand board feet for logging, milling, and selling lumber for this operation was found to be $18.11 for 13-inch trees, $15.62 for 17-inch trees, and $14.25 for 21-inch trees, based on 1929 cost figures. The value per thousand board feet of lumber from 13-inch trees was $23.62, for 17-inch trees $25.64, and for 21-inch trees $27.35, based on 1929 lumber prices. The difference between lumber value and cost of production for the 5-year period for trees 17 inches and over was $4.01 per acre per year and for the 10-year period was $5.26. These returns include interest and margin for profit and risk, and also the cost of growing stumpage, amounting to $.18 per acre per year. At present these returns could not be realized, but present depression conditions are probably less normal than conditions of 1929.

A similar study in a tract of virgin shortleaf-loblolly pine indicated the possibility of a sustained yield of 400 board feet per acre per year in trees 21 inches d.b.h. and larger, cutting over the area every 10 years. Costs of growing stumpage included taxes $.25, fire protection $.05, and administration $.03, a total of $.33 per acre per year. With an average growth of 400 board feet per acre per year, the cost per thousand feet of stumpage is $.82. The value of lumber (1929) in trees 21 inches d.b.h. and larger averaged $32.50 per thousand, while production and selling costs (1929) totalled $17.50 per thousand board feet, leaving a margin of $15 for interest, profit, and risk. With a possible cut of 400 board feet per acre per year, the margin per acre was $6, from which a cost of $.33 for growing stumpage should be deducted. Although this is a slightly greater return per acre than that for second-growth, it is earned on a considerably larger investment than in the case of second-growth and the annual increment is slightly less than for second growth.

In both virgin and second-growth shortleaf-loblolly pine stands it appears advantageous to use selective logging. By cutting the larger trees, better quality and more valuable lumber is obtained and costs of logging and milling per thousand board feet are reduced. The increment may be increased and the quality of product improved by proper selection of trees to be cut. By this method the area is fully utilized, growing trees of all sizes, and natural pruning takes place, resulting in clear logs. A light cut per acre results in a lower fire hazard and in lower fire protection costs than where heavier cuts are made. When fires do occur under selective logging, the killing effect is usually limited to reproduction under 1 inch in diameter, and adequate restocking will take place between fires which may occur every few years. A sustained yield can be obtained indefinitely and the amount of cut can be varied somewhat under changing market conditions without seriously affecting either the quantity or the quality of the increment.

An inventory of private forestry practice in the South was made in 1932 and is summarized in the following table covering the eight States of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, and Texas:

Grade of forestry 1/ practiced	Kind of operation 2/						Total	
	Naval stores		Saw & paper mills		Timber growing 3/			
	Area	Owners	Area	Owners	Area	Owners	Area	Owners
	Acres	Number	Acres	Number	Acres	Number	Acres	Number
Longleaf-Slash Pine Type								
Quality 1	386,000	4	349,500	2			735,500	6
Quality 2	189,500	22	252,500	9	176,000	5	618,000	36
Quality 3	389,500	70	1,515,000	22	520,000	24	2,424,500	116
Total	965,000	96	2,117,000	33	696,000	29	3,778,000	158
Shortleaf-Loblolly Pine-Hardwood Type								
Quality 1			613,500	6			613,500	6
Quality 2			1,343,500	12	23,500	5	1,367,000	17
Quality 3			1,267,500	17	151,000	7	1,418,500	24
Total			3,224,500	35	174,500	12	3,399,000	47
River Bottom Hardwoods and Cypress Type								
Quality 2			107,500	4			107,500	4
Quality 3			475,500	5			475,500	5
Total			583,000	9			583,000	9
Summary								
Quality 1	386,000	4	963,000	8			1,349,000	12
Quality 2	189,500	22	1,703,500	25	199,500	10	2,092,500	57
Quality 3	389,500	70	3,258,000	44	671,000	31	4,318,500	145
Total	965,000	96	5,924,500	77	870,500	41	7,760,000	214

1/ The quality of forest practiced by each individual operator was rated according to the following schedule:

Quality 1 forestry: Adequate fire protection; reasonable minimum diameter cuttin limits; leaving seed trees or selective logging or adequate planting, with or without correct naval stores practice; specific plans of fores management for a long time operation based on adequate inventories and growth studies.

Quality 2 forestry: Effective fire protection with seed trees or planting but without definite plans of actual forest management for a long time operation.

Quality 3 forestry: Fire control with some efforts to produce a new stand.

2/ Individual areas of 1,000 acres or less not included.

3/ Non-operating land owners holding for speculation.

During 1933 case studies will be continued. The best available forest conditions will be selected to study present financial possibilities, and permanent plots will be established for a long-time study of financial possibilities under proper management.

Progress reports of both county and case studies will be made available as completed.

New Public Domain

A general appraisal of the extent and status of tax-delinquency and laws relative thereto in the States of Florida, Georgia, Alabama, Mississippi, Louisiana, Arkansas, Oklahoma, and Texas was completed early in 1932. The estimated tax delinquency in these States is shown in the following table:

(All acres in thousands of Acres)

tate	Total land area	Total forest land area	Total land area reverted to State	Total forest area reverted to State	Total land area delinquent but not reverted 1932	Total forest area delinquent but not reverted 1932	Percent of total forest area		
							Reverted	Delinquent	Involved in delinquency
a.	35,111	23,600	1/ 11,000	1/ 6,500	1/ 4,000	1/ 2,300	27	10	37
.	37,584	22,872	2/ -	-	-	-	-	-	-
a.	32,819	21,680	10	-	50	30	3/ -	3/ -	3/ -
ss.	29,672	18,293	600	300	1,000	500	1	3	4
.	29,062	18,903	1,540	1,080	500	350	6	2	8
k.	33,616	22,000	1,810	1,120	1,230	800	5	4	9
la.	4/ 4,760	4/ 4,279	5/ 450	4/ 100	5/ 270	4/ 60	2	2	4
xas	4/ 17,231	4/ 12,624	890	4/ 330	480	4/ 180	3	1	4
tal	219,805	144,251	16,300	9,430	7,530	4,220	7	3	10

[1] Landowners do not consider their lands reverted to State Title, but believe they can retain title through legislative tax-adjustments. State's title questionable. Same statement applies, with less force, in all Southern States.

[2] No reverted land in Georgia.

[3] Less than 0.5 per cent.

[4] Includes only eastern portion of State, within limits of pine type.

[5] Title passes to county; this figure for entire area of commercial and non-commercial forest land in State.

Arkansas was selected as the State for the first field work in this project. is selection was influenced very largely by the keen interest displayed by the iversity of Arkansas and the Arkansas Agricultural Experiment Station in co-erating on the work on a rather extensive basis, and by the fact that with the ception of Florida, tax-delinquency of forest land was more extensive in this ate than in any other in the South.

Field work was started late in April, 1932, in Drew County by one man om the Station staff assisted by a forester from the University of Arkansas and an agricultural economist from the Arkansas Agricultural Experiment Station. This county has the least delinquency of any in Arkansas, and was selected primarily to test out the Working Plan and the methods of field technique. It also served as a check plot for other county studies. Little River County was surveyed next, the work starting July 6th and being completed September 5th. This county, typical of the shortleaf-loblolly pine-hardwood type of the Upper Red River Valley, had, as of June 1, 1932, approximately 19,600 acres of New Public Domain, and 100,000 acres delinquent for one or two years taxes but not yet certified to the State. Samples of these areas were selected and the plots therein visited and classified as to ownership, residency of ownership, status of delinquency, land-utilization, forest type and condition, topography, stoniness, and erosion. Merchantable stands of timber were covered by a 5 per cent cruise, and site index determined. A detailed study of the public finance and tax-system of the county was made. In Washington County, typical of the oak-hickory type of the Ozark Mountains in northwest Arkansas, a similar survey was begun in late September and the field work completed the end of November. This county was found to have had approximately 18,000 acres of tax reverted land on December 1, 1931, and on October 1, 1932, there were approximately 125,000 acres delinquent for one or two years taxes but not yet certified. Assistance in each of the county studies was obtained from the Arkansas Agricultural Experiment Station and the University of Arkansas.

During the first half of 1933 it is planned to complete the office reports on the three counties already studied, and to finish the field work in two other counties. One of these will be in the shortleaf-hardwood type of the Central Highlands (Johnson County) and one in the Mississippi Delta (Lee County). Based on these county studies, recommendations will be made of practical measures for handling and using reverted forest lands for forestry purposes.

Forest Survey

Upon completion of the field work on the preliminary forest survey of Pearl River County in the longleaf pine region of southern Mississippi in January, 1932, an attempt was made to inaugurate the field work of the survey in the bottomland hardwood region in Mississippi, but continued high water in the Tallahatchie and Yazoo drainages made it impossible to carry on the work, Due to this condition, the upland hardwood sub-region of northwest Mississippi was chosen as the scene of operation during the early part of 1932.

a. Upland Hardwoods

The upland hardwood sub-region of Mississippi, embracing some 2,176,000 acres, lies in the silt loam uplands. It is roughly triangular in shape and is bounded on the west by the loess bluffs at the edge of the Delta, on the north by the Tennessee-Mississippi State line, and the eastern edge adjoins the shortleaf pine region. This is not an important timber region at present but was the source of considerable hardwood timber in the early days. Due to the easily eroded soils and the somewhat rough to rolling topography, much of the former cultivated area has eroded until it can no longer be farmed. It then goes into pasture or is abandoned to come back to forest. The merchantable timber is found mainly in the river and stream bottoms and consist of red gum, various oaks, ash, elm, hickory, and some cypress. Cutting of the various forest commodities is carried on chiefly by small portable mills.

This region will be included in the northern Mississippi release unit which, when completed, will embrace about 8 million acres and cover 27 counties in the northern third of the State. It was considered as a subunit because it includes a region of homogeneous conditions making it somewhat different from the rest of the unit. The data for the upland hardwoods will be combined in the final report with that of the unit as a whole, but may be described separately.

Nine survey lines in this region were run in an easterly direction, starting from designated points at the base of the loess bluffs. The first line was run five miles south of the State line, and each subsequent line was ten miles south of the preceding one. Quarter-acre plots were taken at every 10-chain point along these lines and, if timbered, an accurate tally of all trees one inch and over was made. On the non-forest plots, the non-forest type was noted and the prevalence of erosion described. The field work on the upland hardwood unit was completed April 15, 1932.

The total estimated volume of timber found in the upland hardwood subregion was about 850,000,000 board feet Scribner Decimal "C" scale. This stand occurred on 466,800 acres of forest land. Less than 200,000 acres of th contained stands with 1,500 or more board feet per acre.

Approximately 33 per cent of the total land area showed evidences of erosion, and of the abandoned farm land 48 percent was eroded.

b. Bottomland Hardwoods

The delta portion of Mississippi, a region of 4,420,400 acres, is being set up as a complete release unit; it includes the bottoms lying along and east of the Mississippi River in Mississippi from the Tennessee line to Vicksburg, bounded on the east by the loessal bluffs. From the early part of April until the 13th of August, the field work of the Survey was concentrated in the bottomlands. Nineteen survey lines at 10 mile intervals were run in the area lying between the Tennessee-Mississippi State line on the north and Vicksburg on the south. The field procedure was based on the results of the preliminary survey made in East and West Carroll Parishes, Louisiana, and the field instructions were contained in a comprehensive field manual.

The field work in the Delta required 617 man days. Detailed measurements were taken on 2,301 quarter-acre forest plots out of a total of 5,856 plots.

The data for this unit are now being analyzed. The following tables show the percentage of forest land in the region by condition, by topographic site and by forest type, and the percentage of the various classes of non-forest land.

Mississippi Bottomland Hardwoods
Forest Area by Condition, Site, and Type
Based on Total Area of 4,420,400 Acres

Forest condition	Acreage	Per cent of forest area	Per cent of total area
1. Virgin	92,840	5.3	2.1
2. Virgin culled	98,880	5.7	2.2
3. Virgin cut over	394,030	22.7	8.9
4. Second growth - uncut	843,940	48.5	19.1
5. Second growth-culled	28,680	1.7	.7
6. Second growth-cutover	240,790	13.9	5.4
7. Burned area	15,850	.9	.4
8. Flood killed area	21,890	1.3	.5
Total	1,736,900	100.0	39.3
Forest Site			
1. Bottoms	1,314,900	75.7	29.7
2. Swamp	160,790	9.3	3.6
3. River margin	89,080	5.1	2.0
4. New Batture	170,620	9.8	3.9
5. Uplands	1,510	.1	.1
Total	1,736,900	100.0	39.3
Forest Type			
1. Cypress	59,630	3.4	1.4
2. Cypress-hardwoods	80,760	4.7	1.8
3. Cottonwood-willow	159,260	9.2	3.6
4. Red Gum	36,980	2.1	.8
5. Overcup oak - Pecan	222,670	12.8	5.0
6. Mixed hardwoods	1,177,600	67.8	26.7
Total	1,736,900	100.0	39.3

Distribution of Classes of Non-Forest Land In the Bottomland Hardwood Region of Mississippi Based on Total Area of 4,420,400 Acres

Non-Forest Land	Acreage	Per cent of Total Area
Agricultural		
In cultivation	2,192,100	49.6
" " new ground	127,560	2.9
Abandoned permanently	46,050	1.0
" temporarily	74,730	1.7
Pasture		
Improved	27,930	.6
Woodland	29,440	.7
Other Areas including: Levees, roads, railroads, towns, waterways	185,690	4.2
	2,683,500	60.7 percent

As soon as the field data are completely analyzed and the results tabulated, a report will be prepared, to be made available for distribution.

c. Southern Pine

The data obtained in the preliminary survey of Pearl River County, Miss., have been used as a basis for formulating plans for the survey procedure in the southern pine region. Approximately 3,000,000 acres of land in the shortleaf-hardwood region, constituting part of the northern Mississippi unit, had been covered by the survey field work up to December 31, 1932. No detailed office work or analysis of the data from this part of the unit has as yet been undertaken.

d. General

In addition to carrying on the field and office work as already described, the Survey staff has carried on other work, which, while not directly connected with the inventory phase, is nevertheless an integral part of the project.

Measurements have been taken on several hundred pine and hardwood trees for volume table construction and checking purposes. The hardwood volume tables constructed for the bottomland hardwoods have been checked and with minor changes were found to be applicable to the upland hardwoods.. Tables were constructed for longleaf, shortleaf, and loblolly pines based on data collected in Mississippi and Louisiana. For each release unit these tables will be checked by taking additional measurements on logging operations so that accurate tables will be available for each unit.

Ownership data, tax information, cutting records and other pertinent data were obtained for the units worked.

The growth phase of the survey has been approached from several different angles to determine the most accurate and effective method of arriving at the annual and periodic growth. Studies of mortality have been carried on and have been included in the growth calculated. It was found that shortleaf and loblolly pine trees retained their bark for three years after death. For the hardwoods, the criterion is somewhat different and is based on the length of time it takes the smaller limbs to decay and fall off. This varies with the diameter of the limb; limbs under five inches in diameter usually fall off within five years time.

The analysis of plot data has been simplified. Outlines for release unit reports have been approved and will be followed in preparing the final reports.

The dissemination of information on the aims, objectives, and progress of the survey has been an important phase of the project. This has been accomplished by radio talks, articles published in various trade and technical journals and newspapers, addresses before trade associations and forestry conferences and by numerous conferences with leaders in the various forest industries.

Reconnaissances have been made in advance of work in release units so that the conduct of the work in such new units may be more efficiently planned. In this connection, a "cropmeter" has been used as an accessory for getting data to strengthen and supplement the field work.

Present plans contemplate the completion of the Survey in Mississippi before work in any other state is inaugurated. If cooperative funds are available in other states, the work can be rapidly expanded, additional crews can be organized, and the project can be carried on concurrently in several regions. An insistent demand for the Survey has come from the naval stores interests in Georgia and Florida and it is hoped this demand may result in extending the work to cover simultaneously a larger part of the 200,000,000 acres of forest land in the South that lie ahead of the Survey.

FOREST PATHOLOGY

(Pine) The study of the seedling disease of longleaf pine caused by the brown spot needle disease (Septoria acicola) continues as the main project. Minor projects deal with the studies of slash disposal and of basal decay in southern pines. Another assignment involves the propagation of Asiatic chestnut seedlings in the South.

The larger part of the work with the brown-spot needle blight of longleaf has been done in the field, particularly on areas of natural reproduction near Bogalusa, La. Seedlings on an area of dense natural reproduction are being sprayed frequently to control the disease and measured once a year to determine the effect. The vigor and height of seedlings in sprayed plots leaves no doubt as to the beneficial influence of the treatments. A comparison of the average height growth of seedlings in sprayed and unsprayed plots shows that growth in the sprayed areas exceeded that of the unsprayed in 19 out of 20 pairs of plots during a two-year period.

The effect of the disease in forest plantations is being tested by spraying several hundred planted seedlings and comparing them with adjacent unsprayed plants. By the end of the fourth season in the field, the average diameter of unsprayed stock was only 40 percent of that of adjacent plants sprayed, the spraying having continued ever since seedlings were planted.

The spray treatment employed are listed in order of relative effectiveness for the season of 1932: Lime-sulphur, Bordeaux mixture, zinc-sulphate plus lime, colloidal sulphur, and casein.

The effect of grass and sedge on needle infection is being studied. Complete removal of all herbaceous vegetation from several areas over a period of years doubled the amount of dead needle tissue for the first season, tripled it for the second, and more than doubled it during the third season. These ratios were determined each season by comparing the extent of the disease on the denuded area with that on adjacent undenuded plots. The effect of denuding when continued for three years is cumulative.

An extensive survey was made in the longleaf region from Texas to South Carolina and 73 areas examined to determine the effect of fire as a measure of disease control. It was found that a single fire reduced the disease on all areas for the first season, and to a lesser extent the second season. A second survey covering 72 areas from Louisiana to Georgia gave essentially the same information. It is indicated that during the third season after the fire the disease can be expected to revert to its original status. Annual seedling measurements and control of the disease by spraying, while essentially routine work, are giving valuable information and will be continued through 1933. It is planned to investigate various technical phases of the problem, also, such as spore production, spore dissemination, relative susceptibility of different classes of seedlings, and different ages and types of foliage.

Hardwoods

Study of tree diseases in the bottomland hardwoods of the Mississippi Delta was started in July, 1931, by Dr. L.O. Overholts and Frank Kaufert. This investigation was carried on in 1932 by G.H. Hepting, who centered his efforts in determining the relation of fire to the understocking of young hardwood stands through the dropping out of young trees due to decay following fire scarring on the 19 separate areas studied in Louisiana and Mississippi. He found relatively few trees that had fallen over due to this cause; with few exceptions the trees that had broken over had poor or suppressed crowns. He concluded that fire as a forerunner of decay is relatively unimportant as the cause for understocking compared to its effect in the outright killing of seedlings and the girdling of sapling trees. The data show, however, that fire scars on saplings result in immediate decay and subsequent cull to a greater extent than had been supposed for trees of this size.

Products

Work in forest products pathology has been largely a continuation of devising efficient methods for controlling sap stains and molds in domestic and export lumber, logs, and other forest products. Financial assistance by interested chemical companies and lumber organizations has permitted considerable expansion of the sap stain control work.

The results of 1932 lumber dipping tests have continued to confirm those of previous years; the ethyl mercury chloride and the sodium tetrachlorophenolate treatments have continued to give satisfactory and economical control. The former compound, sold under the trade name of Lignasan, is now being used by some 200 pine and hardwood mills. Borax, found in previous tests to be very effective on hardwoods, has been adopted by one large hardwood company, and is proving fairly satisfactory. Although sodium tetrachlorophenolate has proven effective on hardwoods, it has not yet been put on the market. Its marketing has been held up pending the outcome of tests with a similar product, sodium 2-chloroorthophenylphenolate, tested on a large scale for the first time this year. It seems likely that it will be found useful, and that both compounds will be on the market in the near future. These two compounds are non-mercurial, and under less suspicion of possible toxicity to humans.

Considerable attention was given to the development of suitable equipment for the adoption of dipping practices by small mills. While most of these mills remained shut-down during 1932, considerable progress was made in the application of the new stain control methods. Further work on this problem is planned.

Continued commercial tests of new log treatments showed that where insect occurrence is not a factor, stain can be effectively controlled by a number of economical spray treatments. Insect occurrence has not been found to be heavy in winter stored hardwood logs cut after October 1st, to warrant attempts at control, so that the problem of preventing deterioration in winter-banked logs seems largely solved. For logs cut and stored during the warmer months, however, an insect repellent treatment is necessary. Several compounds have proven partially effective, but none have been found wholly satisfactory. The search is being continued.

A still wider field of use for the lumber dipping treatments is indicated by the promising results obtained to date in the experimental pole and piling pre-treatment work. It seems likely that through the use of certain dips and spray treatments, the decay hazard can be lessened in pine poles, posts, and piling that are to be stored or air-seasoned prior to creosote treatment. The experimental data do not yet justify delaying creosote treatment beyond the usual time as a result of pretreatment.

In addition to the field work outlined above, several problems of controlling stain and mold occurrence in other classes of products, such as staves, furniture squares, and blocks are receiving attention. Further laboratory work on the dissemination phases of the stain problem, strength tests of treated and untreated air-seasoned lumber, and preliminary tests on new chemicals are also planned for 1933.

13,27.

AGRICULTURAL REFERENCE DEPARTMENT
CLEMSON COLLEGE LIBRARY

R - SS
Investigative Program

March 21, 1934

THIRTEENTH ANNUAL REPORT
# of the
SOUTHERN FOREST EXPERIMENT STATION

New Orleans, La.

January 1, 1933 - December 31, 1933

STAFF
SOUTHERN FOREST EXPERIMENT STATION
January 1, 1933 - December 31, 1933

E. L. Demmon	Director
I. F. Eldredge	Principal Forest Economist
W. E. Bond	Forest Economist
G. H. Lentz..(resigned Oct.11,1933)	Silviculturist
A. E. Wackerman	Forester
W. G. Wahlenberg	Associate Silviculturist
P. C. Wakeley	Associate Silviculturist
Lenthall Wyman	Associate Silviculturist
L. J. Pessin	Associate Forest Ecologist
P. V. Siggers..(Forest Pathology-B.P.I.)	Associate Pathologist
Henry Bull	Assistant Silviculturist
E. W. Gemmer	Assistant Silviculturist
V. L. Harper	Assistant Silviculturist
R. K. Winters	Assistant Silviculturist
R. B. Craig	Assistant Forest Economist
M. M. Lehrbas	Assistant Forest Economist
F. K. Beyer..(resigned Sept.17,1933)	Junior Forester
C. A. Bickford	Junior Forester
R. A. Chapman	Junior Forester
J. W. Cruikshank	Junior Forester
V. B. Davis	Junior Forester
E. B. Faulks	Junior Forester
E. A. Foster..(resigned June 2,1933)	Junior Forester
F. D. Heyward	Junior Forester
T. A. Liefeld	Junior Forester
H. G. Meginnis	Junior Forester
C. F. Olsen	Junior Forester
J. G. Osborne	Junior Forester
J. A. Putnam	Junior Forester
R. R. Reynolds	Junior Forester
A. R. Spillers..(resigned Nov.12,1933)	Junior Forester
P. R. Wheeler	Junior Forester
T. E. Pease	Senior Forest Ranger
R. M. Barnette-(Fla.Agric.Exp.Station- Agreement Terminated June 30, 1933)	Agent
A. D. Chapman-(Forest Pathology-B.P.I.- Appointment Terminated June 30, 1933)	Agent
T. C. Scheffer..(Forest Pathology-B.P.I)	Agent

(over)

J. A. Lubbe	Jr. Administrative Assistant
Vera S. Lind	Senior Clerk
Effie H. Hunt	Clerk-Stenographer
Bettie C. Busch.(resigned Nov.30,1933)	Clerk (Statistical)
Mary C. Regan	Asst. Clerk (Statistical)
Lucille P. Olsen	Junior Clerk (Statistical)
Camelia M. Larsen	Asst. Clerk-Stenographer
Agnes G. Terburg - (Full time to Dist. Forest Inspector's Office, July 1, 1933)	Asst. Clerk-Stenographer
Elizabeth Bergland	Junior Clerk-Stenographer
Marie M. Flad	Junior Clerk-Stenographer
Mary S. Gloger	Junior Clerk-Stenographer
Ruth Marshall	Junior Clerk-Stenographer
May M. Patchett	Junior Clerk-Stenographer
Leo W. Cooper	Junior Messenger

TEMPORARY STAFF

Field Assistants:

W. R. Becton (Surv.)
R. E. Brown (Surv.)
T. S. Coile (S.I.-Nira)
T. E. Evans (F.A.-Nira)
Robt. Fokes (Surv.)
C. S. Herrick (ME-2)
W. L. Keel (N. S.)
Togo McKeithen (Surv.)
H. G. Posey (Surv.)
A. D. Read (F. A.)
A. F. Verrall (Path.)
A. G. Watkins (S. I.)

Technicians-(Nira)-Assigned to Survey, beginning October, 1933:

C. H. Caskey
W. P. David
R. Y. Edmondson
A. D. Ernest
M. S. Kahler
F. J. Lemieux
J. R. Nevers
L. E. Price
J. W. Reno
H. F. Smith
J. M. Tinker
W. J. Welsh
N. M. White
R. E. Womack
W. E. Wright

Assistant Technicians-(Nira)-Assigned to Survey, beginning Oct. 1933:

R. S. Andrews
L. E. Baker
R. W. Bryce
C. H. Carr
C. E. Edmondson
L. W. Forgey
B. M. Franklin
J. P. Hale, Jr.
A. M. Harrison
T. P. Hursey
J. P. Johnson
L. F. Landry
G. B. Lane
W. F. Mershon
R. L. Moseley
D. G. O'Kelly
A. A. Pierce
J. G. Rawls
W. C. Ring
H. O. Seymour
C. T. Snowden
J. F. Spiers
A. G. Steedley
L. S. Tate
W. H. Thompson
W. J. Tinney
A. D. Toler
A. D. Vickers
Leroy Willis

Office Force - (Nira) - Beginning October 1933:

Florence V. Alexander	Junior Clerk-Stenographer
Julia O. Dumestre	Junior Clerk
Pearl S. Holland	Junior Stenographer
Elsa M. Rayl	Clerk

SOUTHERN FOREST RESEARCH ADVISORY COUNCIL

L. J. Arnold, Manager, Crossett Lumber Company, Crossett, Arkansas.

L. Warrington Baldwin, President, Missouri Pacific Railroad Company,
St. Louis, Missouri.

W. H. Barnwell, Georgia Power Company, Atlanta, Georgia.

Col. R. E. Benedict, Brunswick Peninsula Company, Brunswick, Georgia.

Col. P. S. Bunker, State Forester, Montgomery, Alabama.

Prof. H. H. Chapman, Yale University, New Haven, Connecticut.

L. O. Crosby, President, Goodyear Yellow Pine Lumber Company,
Picayune, Mississippi.

Col. D. T. Cushing, General Manager, Great Southern Lumber Company,
Bogalusa, Louisiana.

Mark Fenton, General Industrial Agent, Illinois Central System,
Chicago, Illinois.

Hon. H. E. Hardtner, President, Urania Lumber Company, Urania,
Louisiana.

Dr. Chas. H. Herty, Research Chemist, Savannah, Georgia.

F. M. Joy, Tennessee Coal, Iron, and Railroad Company, Birmingham,
Alabama.

A. L. Kuehn, President, American Creosoting Company, Louisville,
Kentucky.

Prof. G. D. Marckworth, Georgia Agricultural College, Athens,
Georgia.

Dr. Wilmon Newell, Director, Agricultural Experiment Station,
Gainesville, Florida.

F. W. Scott, General Manager, Union Sawmill Company, Huttig, Arkansas.

E. Marvin Sessoms, Vice-President, Consolidated Naval Stores Company,
Jacksonville, Florida.

C. C. Sheppard, General Manager, Louisiana Central Lumber Company,
Clarks, Louisiana.

E. O. Siecke, Director, Texas Forest Service, College Station, Texas.

Carl F. Speh, Secretary-Manager, Pine Institute of America, Inc.,
Jacksonville, Florida.

T. G. Woolford, President, Retail Credit Company, Atlanta, Georgia.

TABLE OF CONTENTS

Page number

Forest Situation in the South 1
Progress during 1933 5
Personnel 6
Advisory Council 7
Centers of Work 8
Natural Areas 9
Work with Emergency Funds:
    1. Emergency Construction 9
    2. Emergency Conservation Work (ECW) 10
    3. National Industrial Recovery Act (NIRA) 11
    4. Civil Works (CWA) 11
Current Investigations:
  Fire 12
  Management:
    1. Natural Reproduction 14
    2. Methods of Cutting 15
    3. Thinning 17
    4. Stand Betterment 18
  Forestation 19
  Measurements:
    1. Southern Pines 20
    2. Hardwoods 23
  Naval Stores:
    General 23
      1. Methods of chipping:
        (a) Height of streak 24
        (b) Back-facing 24
        (c) Tin raising 24
        (d) Interval of chipping 25
      2. Tree factors 25
      3. Weather relationships 25
      4. Naval stores and fire 27
      5. Naval stores management 28
  Erosion-Streamflow 28
  Financial Aspects of Private Forestry 31
  New Public Domain 32
  Forest Survey 35
  Forest Pathology 36
  Products Pathology 37
Plans for 1934 39

THIRTEENTH ANNUAL REPORT
# of the
SOUTHERN FOREST EXPERIMENT STATION

January 1, 1933 - December 31, 1933

This report summarizes the progress of forest investigations under way at the Southern Forest Experiment Station during 1933 and outlines plans for 1934. It is the thirteenth of a series of reports that have been issued annually since the Southern Station was established in July, 1921. This federal station, one of eleven regional forest experiment stations in the United States, serves the territory extending from Georgia and Florida westward to Texas and Oklahoma and includes a major part of that section of the country known as the "South."

THE FOREST SITUATION IN THE SOUTH

During the last year it has been possible to evaluate more accurately than ever before the eminent position which the South holds as a source of forest products for the nation. During 1932 and 1933, the United States Forest Service made a comprehensive survey of the forestry situation in the United States, in which a number of members of the Southern Station contributed, both in the preliminary work as well as in the preparation of portions of the final report. This publication, which appeared early in 1933 as the "Copeland Report" (A National Plan for American Forestry; Senate Document 12, 73d Congress, 1st Session, 1933), gives up-to-date information on the importance of southern forests. A brief summary of these findings will be presented here as an introduction to this annual report of the Southern Forest Experiment Station. The South as referred to in this compilation of data comprises the eleven southern states from Virginia to Texas, or three more states than are included in the Southern Station's territory, (Virginia, North Carolina, and South Carolina).

The South leads all other sections of the United States in area of commercial forest land, with 191 million acres or 39 percent of the total for the country. Within its borders, 73 percent of all land is either in forest or has been cut over and now lies idle; 64 percent of its gross area is commercial forest land. As the acreage of agricultural crops in the South declined over a million acres between 1920 and 1930, there is no reason to believe that any considerable part of the South's forest land will be needed for agricultural development in the near future.

While the South has about 200 billion board feet in merchantable saw timber, this amounts to but 12 percent of the volume of merchantable saw timber of the nation, exceeding in this respect, however, all other regions except the Pacific Coast. From the standpoint of industry, the forests of the South rank second only to agriculture in importance.

As a field for forestry development, the South has outstanding advantages, among which are its great number of valuable fast-growing native timber species, its long growing season, its abundant rainfall, the comparatively easy logging conditions, the relative ease and low cost at which forest crops can be produced, and its proximity to great timber markets.

The vast forest empire included in the eleven southern states, from Virginia to Texas, consists of four principal types of forests: (1) longleaf-slash pine; (2) shortleaf-loblolly pine; (3) upland hardwoods; and (4) bottomland hardwoods. Sixty-eight percent of the total commercial forest area is occupied by pine types, the balance being in hardwoods.

Types of forests	Area of commercial forest land (1930)	Proportion each type represents of total
	Thousand Acres	Percent
Longleaf-Slash	53,719	28
Shortleaf-Loblolly	75,690	40
Bottomland Hardwoods	26,411	14
Upland Hardwoods	34,854	18
Total	190,674	100

The original virgin timber remains uncut on about 14 million acres, or on 7.5 percent of the total commercial forest area. An equal area has been so severely cut or burned that it will not reproduce naturally in commercial quantities within 20 years. The balance of the commercial forest area, 163 million acres, is in second-growth ranging from seedlings to saw timber, which has replaced the original forest stands. In 1930 second-growth stands made up 65 percent by volume of all the merchantable saw timber in the region. This ability to regenerate rapidly and produce saw timber at an early age is a very important factor in the practice of forestry in the South.

Practically all the forest land in the South is in private ownership; 98 percent of the area and 98 percent of the volume of timber are in private hands, if the 12 1/4 million acres of tax-forfeited forest lands (8 percent of the total forest area) are included as private lands. Nearly one-half of all privately owned forest land in the nation is in the South.

From the standpoint of current growth of wood, the South exceeds all other forest regions of the nation. In total volume of saw timber and cordwood combined, the United States Forest Service estimates show the South's commercial forests to be producing at the current growth rate of about 4.8 billion cubic feet annually, or 54 percent of that for the United States as a whole. In saw timber growth alone, the forests of the South are growing currently 6.8 billion board feet per year (softwoods, 4.9 billion; hardwoods, 1.9 billion), or 58 percent of the total for the United States. For the 1925-29 period, the saw timber and cordwood stands in the South were being depleted one and one-half times as fast as they were growing; the saw timber stands alone were being depleted almost four times as rapidly as their current growth rate. On the basis of estimates of the normal future requirements of the United States as a whole, the forests of the country are being depleted twice as fast as they are currently growing in cubic feet, or five times as rapidly for saw timber alone. This indicates that depletion of southern forests is not progressing as rapidly in relation to growth as it is in the rest of the United States.

In 1932 the South produced 37 percent of the nation's softwood lumber and more than 50 percent of its hardwood lumber. In the same year the South provided 41 percent of the volume of forest products exported from the United States, valued at over 30 million dollars, or 64 percent of the total value of all such exports. This region also contains 42 percent of the volume of all pulpwood species in the United States, a volume which is increasing through natural growth more rapidly than in any other region.

In 1929 the forest industries of the South employed 24 percent of the persons employed in all manufacturing industries, paid 19 percent of all wages paid, and produced 10 percent of the value of all manufactured products.

Forest Industries in the South - 1929 *

Forest industries	No. persons employed	Salaries and wages	Value of manufactured products
		Dollars	Dollars
Lumber and cooperage	245,853	206,114,610	629,205,916
Turpentine and rosin	41,740	16,977,385	36,281,632
Pulp and paper	4,722	6,801,092	52,706,567
Wood distillation	2,090	2,468,781	10,133,454
Total	294,405	232,361,868	728,327,569

* Data from Census Reports

All of the country's naval stores (turpentine and rosin) are produced in the southern states and these represent about two-thirds of the entire world production. As a southern industry, the production of naval stores is exceeded only by agriculture and lumbering.

The products of the southern farm woods produced an income for farmers of over 82 million dollars in 1929 and ranked fourth among all agricultural crops, being exceeded only by cotton, tobacco, and potatoes.

Southern forests exert a beneficial influence in protecting water supplies, preventing erosion, and in flood control. One of the most obvious contributions which forests make towards preventing destructive floods and regulating streamflow lies in the protection which tree growth affords in preventing and checking erosion. Although examples of excessive erosion are to be found in all sections of the country, the problem is particularly serious through the Mississippi valley and on the Piedmont and rolling coastal plain country in the southeastern United States.

Southern forests are also important for the recreational opportunities they afford. In 1929 there were estimated to be about 4,420,000 hunters and fishermen in the South, of whom probably 3,500,000 obtained their recreation on forest lands. It is also estimated that during the decade ending in 1930, the number of hunters and fishermen throughout the United States increased by 400 percent. With the increase in leisure brought about by shorter hours and fewer days of work, it is likely that the use of southern forests for recreation by hunters and fishermen is constantly increasing. Management of forests for game production alone is already a profitable enterprise to many owners of southern forest land. In the pinelands of the Southeast it has been estimated that the quail crop has an established market value for leasing purposes of about 15 cents per acre per year. This amount, which could no doubt be increased under intensive management, indicates the intrinsic value of forest land for only one form of recreation.

The industrial opportunity for forestry in the South is not surpassed by any other forest region in the United States. This opportunity has increased as the original stands of virgin forest have gradually disappeared and as the use of the products of second-growth forests has increased. The Copeland Report indicates that forestry practice beyond simple fire protection is in force on over 4 million acres in the South. This includes two grades of forestry practice: (1) conservative cutting, planting, leaving seed trees, and other practical measures for improving production, without definite plans for sustained yield, are found on some 2,750,000 acres; and (2) permanent forest-land management and organized plans for sustained yield are in effect on over 1,300,000 acres.

To many people forestry conveys the idea of planting trees. The South is fortunate in that most of its commercially important species can be reproduced before or during logging, or by leaving a few trees for natural reseeding after logging, without resorting to planting. There are extensive areas in the South, however, which have been cut so clean or burned so severely that forests can be re-established only by artificial means. It is estimated that during the next 20-year period an area of 5,570,000 acres in the South could well be planted to forest trees. The estimated cost of such a program6will range from $3 to $7 per acre. The magnitude of such a program can be gaged by the fact that the total area planted in the South prior to 1932 totalled only 73,248 acres. Practically all of this planting was by private agencies; about two-thirds by lumber companies and the balance by farmers.

There is good reason to believe that the South, with its many advantages for forestry developments, will continue to be an outstanding region from the standpoint of the production of timber and other forest crops and that the forest industry will take high rank in the South's economic future as it has in the past. Southern landowners are fortunate in having these opportunities and should be prepared to take full advantage of them.

Although the South possesses excellent possibilities for timber growing, it is greatly in need of additional basic forestry information in order to take full advantage of its opportunities. This basis for forestry can best be obtained through a broad forest research program. The forest problems of the South are complicated by the wide range of climatic and soil conditions it encompasses, its great variety of timber species and types, and the multiplicity of forest products available from its forests. The Southern Station's program has been built up over the past several years to concentrate on the most important problems of growth, protection, and use of the South's forest land resources.

STATION PROGRESS DURING 1933

In spite of a 30 percent cut in the regular Station funds for the fiscal year beginning July, 1933, which necessitated a sharp curtailment in field work, the Station has made good progress on its regular program. Some of this progress has been made possible by the allotment of emergency funds under the federal employment relief program. The additional labor and materials made possible by these funds have been used mainly in development work on experimental forests and in providing assistance needed to bring office work more nearly up to date.

The main achievements during 1933 can be summarized as follows:

1. Completion of first drafts of six major manuscripts for publication, under the following titles: "Forest Fires in the South;" "Artificial Reforestation in the Southern Pine Region;" "Cattle Raising and Timber Growing in the South" (in cooperation with the Bureau of Animal Industry and Bureau of Plant Industry); "Variation in Naval Stores Yields Associated with Weather and Elapsed Time since Chipping;" "The Effect of Frequent Fires on the Chemical Composition of Forest Soils in the Longleaf Pine Region" (in cooperation with the Florida Agricultural Experiment Station); and "Financial Aspects of Growing Southern Pine in

2. Selection and initiation of development work on several new experimental forests, as well as the continuation of development of the Olustee experimental forest; in part through the use of emergency funds.

3. Assistance in the preparation of parts of the Copeland Report ("A National Plan for American Forestry").

4. Assistance to the Emergency Conservation Work program in stand-betterment and erosion control measures in the South by the preparation of E.C.W. Forestry Publication No. 3, entitled "Stand Improvement Measures for Southern Forests."

5. Assistance in the formulation of conservation measures under Article X of the Lumber Code as it applies to the southern pine, southern cypress, and southern hardwood forests.

6. Making available current Station findings through the medium of a series of multigraphed notes, called "Southern Forestry Notes," distributed in cooperation with State and Extension Foresters in the South. (There were four issues in 1933, beginning with No. 1 in June.)

The great increase in forest activities in the South during 1933, such as the Emergency Conservation Work through the Civilian Conservation Corps, the creation of a forestry department under the Tennessee Valley Authority, the greatly expanded national forest acquisition program, and the acceptance by the lumber industry of a conservation clause in their NRA Code to provide for "conservation and sustained production of forest resources," have emphasized the urgent need for basic information which forest research should supply. This can best be attained by an immediate expansion of the present forest research program, if the facts and information necessary for the efficient conduct of the above mentioned forest activities are to be supplied.

PERSONNEL

During 1933 the Station lost four of its regular technical staff through resignations: G. H. Lentz and A. R. Spillers to accept positions in the forestry department of the newly organized Tennessee Valley Authority; Ellery Foster to enter the administrative branch of the U. S. Forest Service in the Lake States region; and F. K. Beyer to accept a research teaching fellowship at Cornell University. Because of the curtailment in funds it was necessary to terminate, on June 30, 1933, the cooperative agreement with the Florida Agricultural Experiment Station, whereby Dr. R. M. Barnette spent a portion of his time on the Station's naval stores and fire project. The Bureau of Plant Industry found it necessary to reduce its force at the Southern Station on July 1, 1933, when it terminated the appointment of A. D. Chapman, Agent.

The emergency funds allotted to the Station have been used in part to employ additional technical men, particularly for the Forest Survey. During the latter part of 1933 the technical personnel was increased by 46 men and the clerical force by four under the National Industrial Recovery Act (NIRA) Program. Additional help was provided by the Civil Works Act. The status of Station personnel on December 31, 1933, was as follows:

	Regular Positions 1/			Temporary Positions (Emergency Funds)			
Project:	Technical	Clerical	Total	NIRA Technical	NIRA Clerical	2/ ECW Labor	3/ CWA Allotment
Administration	1	5	6	0	1	0	2
Forest Management	16(2)	4(1)	20	1	0	27	287
Erosion-Streamflow	1	0	1	0	0	1	2
Financial Aspects of Forestry	4(1)	2	6	1	0	3	71
New Public Domain	1	0	1	0	0	0	7
Forest Survey	10(2)	2	12	45	3	0	0
Forest Pathology (B.P.I.)	3(1)	0	3	0	0	0	1
Total	36 (6)	13(1)	49	47	4	31	370

1/ - Vacancies are included in with the number of regular positions and are also shown separately in parentheses.

2/ - Average number of men used daily from Civilian Conservation Corps Camps for 6-months period (July 1 to December 31, 1933).

3/ - About 85 percent of total number are engaged in development work on experimental forests; work began during latter part of December, 1933.

ADVISORY COUNCIL

The Southern Forest Research Advisory Council, comprised of 21 business, professional, and scientific men, appointed by the Secretary of Agriculture and representing forest and allied industries in the Station's territory, acts in an advisory capacity to the Southern Station. No formal meeting of the Council was held during 1933. However, the members were kept informed periodically of the Station's activities. A list of present membership appears in the first pages of this report.

CENTERS OF WORK

The Station's field investigations during 1933 were centered mainly at six branch stations: Urania and Bogalusa in Louisiana, McNeill and Holly Springs in Mississippi; and Camp Pinchot and Lake City in Florida. Only the latter two centers are located on national forest land.

The recent establishment of new national forests in various parts of the South and the availability of emergency unemployment relief funds have made it possible to select and develop additional experimental forests on federally owned land. New centers of work have been selected on the Biloxi National Forest in southern Mississippi (longleaf type), on the Homochitto National Forest in southwestern Mississippi (shortleaf-loblolly-hardwood type), and on the Catahoula and Evangeline units of the Kisatchie National Forest in west central Louisiana (longleaf type). It is planned to make the area on the Biloxi Forest a primary center of work; the others are considered of secondary importance. In addition to these experimental areas, action has been initiated to acquire the McNeill (Mississippi) tract, which it is proposed to develop as a secondary branch. An area in the shortleaf-loblolly country in southern Arkansas is being acquired by gift and will be developed into a primary center of work; this forest will represent the optimum conditions of forest growth found in southern Arkansas and northern Louisiana. The erosion-streamflow investigations at Holly Springs, Mississippi, will be centered on an experimental forest as soon as a suitable area on the Holly Springs National Forest has been set aside for that purpose.

Additional centers of work are planned for the Ouachita National Forest, Arkansas (shortleaf type), and on national forests proposed but not yet established in eastern Texas (shortleaf type), in the Delta bottomland hardwood region of either Louisiana, Mississippi, or Arkansas, and in the Piedmont region of Georgia (shortleaf-loblolly type).

Such a series of primary and secondary experimental forests will be of inestimable value in working out an orderly program of forest research. It will assure to the Station's field investigations a greater degree of permanency, better protection from fire and grazing, and easier supervision, besides bringing research closer to the administrative organization on the national forests, where the results of research can be more readily applied and where the experimental forests can at the same time serve as demonstration areas. A series of well located experimental forests, representing the principal soil and forest types in the South, will furnish the basis for a well rounded research program in the future and will fulfill one of the most urgent needs of the Southern Station.

Considerable time of the permanent Station Staff will go into the development of these experimental forests during the coming year. This work will entail the erection of permanent headquarters and laboratory buildings at the primary centers of work and the construction of roads, fire-breaks, fences, etc., essential to put these and the secondary areas in best condition for research work. Considerable time will also be needed for surveys and mapping, which are an essential prerequisite to the initiation of intensive investigative work.

NATURAL AREAS

Provisions have been made for the setting aside portions of national forest lands to preserve permanently examples of old growth in each of the major forest types. Such tracts are known as "Natural Areas." They will furnish examples of characteristic plant and animal life and soil conditions for purposes of science, research, and education. It is highly desirable that such examples of old growth timber be acquired or set aside at an early date as the relatively small area of virgin stands in the South is rapidly being depleted by industrial operations. Where it is impossible to set aside areas of virgin timber, suitable tracts of second-growth forest will be designated as "Natural Areas" and allowed to develop unmolested.

Selection of "Natural Areas" is made upon the joint recommendation of the research and administrative divisions of the Forest Service. To date one such area in the South has been set aside, an example of virgin longleaf pine on the Choctawhatchee National Forest in western Florida. Another area on the Osceola National Forest in northeast Florida has been tentatively selected, but has not as yet been formally designated. The Station has recommended the acquisition of some virgin longleaf pine in the Kisatchie National Forest in western Louisiana. It is planned to recommend setting aside additional "Natural Areas" until all forest types and conditions of major importance in the South are well represented. In many cases such areas will be located in conjunction with experimental forests.

WORK WITH EMERGENCY FUNDS

Federal emergency relief programs during 1933 have made possible some expansion in regular Station projects and in development work on experimental forests, although funds have been used in part to offset drastic curtailments in regular appropriations. The emergency programs come under four classifications: Emergency Construction; Emergency Conservation Work (ECW); National Industrial Recovery Act (NIRA); and Civil Works Administration (CWA).

1. Emergency Construction

The Station was allotted the sum of $11,171 for the purpose of constructing a group of buildings on the Olustee Experimental Forest, 11 miles east of Lake City, Florida. These buildings include a ranger's house and garage, a laboratory and greenhouse combined, an office building, an equipment depot and workshop combined, a 4-car garage, an automobile service building, a water tower and pump house, and the necessary light, power, and water development. This building program was completed during the summer of 1933 and provides excellent facilities for field laboratory work and for the efficient development of field research on the Olustee Experimental Forest.

2. Emergency Conservation Work (ECW)

Many of the Station's projects have been aided materially by assignments of labor from the Civilian Conservation Corps, the men in all instances working directly from the camps, but under the general supervision of members of the Station staff. Help of this kind has been available from both Federal and State camps, and at such times as the men were needed on going projects. Boys from the C. C. C. work on an eight-hour daily schedule, including time to and from camp, and also a five-day week. Assignments to Station research projects began in August, 1933, and up to December 31, a total of 3,840 man-days of C. C. C. labor had been utilized. Some of the C. C. C. labor was employed more or less continuously on certain projects; on others it was available for short periods of time, as needed. The distribution of this labor according to centers of work and man-days was as follows:

Center of Work or Project	State	Type of Camp	No. of Man-days
Olustee	Florida	National Forest	2,076
Camp Pinchot	Florida	National Forest	161
Urania	Louisiana	Private	1,000
Bogalusa	Louisiana	Private	63
Crossett	Arkansas	Private	403
Holly Springs	Mississippi	Erosion	94
Loxley	Alabama	Private	43
Total Man-days			3,840

The work at the Olustee Experimental Area was varied, consisting of headquarters improvement, fencing, building of naval stores chipper's cabin, construction of fire-lines and motorways, establishment of a small forest nursery, etc.

At Urania, Louisiana, 1,250 acres were cleared of brush and of small hardwood trees for a large scale stand betterment experiment in Greeley Pasture, an area under long term lease to the Station. Large defective or "wolf" hardwoods were girdled.

At Crossett, Arkansas, all trees 13 inches and over d.b.h. on 2,561 acres of virgin shortleaf and loblolly pine forest, totalling 18,157,000 board feet, were measured and tallied, in connection with the Station's study of the financial aspects of timber growing. A detailed growth study was made on a smaller area.

In addition, 10 miles of boundary line of the proposed experimental forest area were surveyed and 4 1/2 miles of road right-of-way staked out.

The scrub oak overstory was cleared away from young longleaf pine on 300 acres at Camp Pinchot, Florida, as a large scale experiment in stand betterment, using a variety of methods and tools. Forty acres of scrub oak were burned over to eliminate the oak preparatory to planting to longleaf pine.

At Holly Springs, Mississippi, 87 dams of various types were built for erosion control research purposes. These dams totalled 612 linear feet. One-third mile of 3-strand barbed-wire fence was built.

The composition-density study plots at Bogalusa, Louisiana, were sprayed and weeded, and the oak sprouts removed. Sixty-six bushels of longleaf pine cones were collected. The men helped also in the annual remeasurement of the plots.

C. C. C. labor helped in the establishment of two series of thinning plots in 18-year-old longleaf pine near Loxley, Alabama.

3. National Industrial Recovery Act (NIRA)

An allotment of $230,806 of Nira funds has made it possible for the Station to expand its program along many lines, not only in the development of experimental forests, but particularly in speeding up the Forest Survey. Of this total allotment, $187,203 is allotted to the Survey. The Survey personnel was increased during October, 1933, by 45 field men and three clerks. Plans are under way to complete the survey of the active naval stores region as rapidly as possible.

Other Nira funds are to be used for the construction of buildings, fences, roads, and fire-breaks, and other improvements on experimental forests, and a limited amount has been allocated to current research projects. Two technicians are being financed from this latter portion of the funds.

4. Civil Works (CWA)

The Civil Works unemployment relief program, inaugurated late in 1933, is supplying the Station with temporary skilled and unskilled labor on a number of projects. Initial assignments began on December 18, 1933, and the Station's quota was rapidly recruited, the maximum allotment being 372 people. The great majority of these were put to work in the field developing experimental forest areas, although it was also possible to increase the office personnel at New Orleans, Louisiana, and Lake City, Florida.

The work accomplished in December was not great, owing to the necessity of organizing crews, obtaining tools and equipment, and training men to their jobs. This took the entire time of several members of the regular staff. In the office it was possible to begin library classification with two librarians; the herbarium is being revamped with the aid of a trained botanist; and accumulated work will be brought up to date with the aid of a number of computers, statistical clerks, and stenographers.

CURRENT INVESTIGATIONS

Fire

The first draft of a manuscript on "Forest Fires in the South" was submitted to the Washington Office in October, 1933. This manuscript summarizes all available data on the effects of fire on southern forests, but it is realized that much more information will be needed before our knowledge of the fire problem in the South can be considered adequate. The importance of the problem is emphasized by statistics on the occurrence of forest fires in the 11 southern states, from Virginia to Texas, which are given in the following table for the five-year period 1928-1932, inclusive. This represents a compilation from State Foresters' records, although the figures for area of unprotected land burned are but rough estimates.

The data cover only private and state lands protected through cooperation of the state and federal government with the land owners (except in Arkansas) and are based on a total forest area for the 11 states of 200,540,000 acres.

	Forest area protected		Protected forest area burned		Unprotected forest area burned		Total forest area burned	
Calendar year	Total	Percentage of total forest area	Total	Percentage of forest area protected	Total	Percentage of forest area unprotected	Total	Percent age of total fores area
	Thousand acres		Thousand acres		Thousand acres		Thousand acres	
1928	47,664	24	1,777	4	39,012	26	40,789	20
1929	53,703	27	1,583	3	41,162	28	42,745	21
1930	56,210	28	2,304	4	44,968	31	47,272	24
1931	51,766	26	1,482	3	43,973	30	45,455	23
1932	46,845	23	1,791	4	38,871	25	40,662	20
5-year average	51,238	26	1,787	3.5	41,597	28	43,384	22

Most of the Station's regular fire studies are concerned with the effects of fire in second-growth pine stands, where established plots are burned at different seasons of the year, annually or periodically, and compared with the unburned check plots. Many other Station projects are tied in very closely with the fire problem, particularly the forest management studies of the relation of controlled fire to the establishment of longleaf pine reproduction.

Progress reports were prepared during 1933, covering the first 10 years' results of the Urania loblolly fire plots and the 5 and 10-year results at McNeill on second-growth longleaf. The reexamination of plots established in 1932 to determine the effect of a severe single fire in the longleaf-loblolly type at Urania and in loblolly and slash pine plantations and naturally stocked longleaf at Bogalusa showed clearly that accurate damage can not be determined until at least a year after the occurrence of the fire. The influence of a single fire in cutting down height growth continues through the second season following a severe fire. Observations on these plots will be continued annually until growth returns to normal.

One new fire damage plot was established at Bogalusa, to study the effect of an accidental fire in April, 1933, which burned 300 acres of an 8-year-old loblolly plantation, following eight years of complete protection; 42 percent of the stand was dead one month after the fire and the mortality had increased to 63 percent six months after the fire. Height growth during the 1933 growing season averaged 6 inches on the survivors compared to 18 inches on adjacent unburned trees. The stand ranged up to 16 feet high at the time of the fire.

Controlled burning as a protection measure was tried out on 400 acres of loblolly and longleaf land near Urania, Louisiana, where the stands were well stocked and ranged from seedlings to seed trees. No fires had occurred for many years previously and the undergrowth and litter were heavy. The fires were set during damp periods, or at night, and although many small trees were killed they were not an essential part of the stand, as the area was already fully occupied by older growth trees. The fire hazard was greatly reduced, at least for the following season; the cost was around two cents per acre. Further studies of controlled burning in this type are planned.

At Lake City, Florida, a new fire study was initiated on longleaf land (Section 18), and the first burns were made early in March, 1933. The study will deal with the establishment, survival, and growth of longleaf pine, from seedlings to tree size and the areas burned over will be sufficiently large to simulate controlled burning on a large scale. The area to be burned annually totals 68 acres; at 3-year intervals, 94 acres; at 6-year intervals, 82 acres; and the unburned check, 125 acres. On these four conditions 229 circular tenth-acre plots, evenly spaced, were established and complete descriptions taken of all trees. Seventeen additional plots, from 0.4 to 0.8 acre each, were established in well stocked sapling and second-growth longleaf stands. Complete data are being obtained on the controlled fires, their cost, the difficulties involved, and their effects, both beneficial and detrimental.

Management

The Station's forest management investigations include studies of natural reproduction, cutting methods, thinning, and stand betterment. These studies are at present limited to the pine types as no funds are available for studies in the hardwoods.

1. Natural Reproduction

A comprehensive report has been prepared covering the past 10 years of research on the grazing and longleaf reforestation experiment at McNeill, Mississippi. This report includes the work of the Bureau of Animal Industry and Bureau of Plant Industry, cooperating with the Forest Service at McNeill, and was prepared jointly by Messrs. Wahlenberg, Greene, and Reed of the three Bureaus. It is being put into shape for possible publication as a government bulletin. The report is not final, as the study is still incomplete, but interesting progress has been made and some suggestions on land management are now available. The report indicates that moderate and controlled use of fire has a definite place in the management of cut-over longleaf pine lands when beef cattle and timber are the major products.

The germination and early survival of longleaf and slash pine is being studied near Lake City, Florida, where supplementary studies of fundamental points can now be made in the new field laboratory. The effect of various surface conditions on the regeneration of pine will be studied in the woods, while laboratory work is expected to reveal some of the limiting factors in soil and moisture relationships.

The development of longleaf pine seedlings in their later stages are being observed at Lake City, Florida, and Urania, Louisiana, in connection with extensive trials of periodic burning for silvicultural purposes. More intensive studies of various factors affecting the early growth of longleaf pine seedlings are under way at Bogalusa, Louisiana. The reproduction of loblolly and shortleaf pines is under observation at Urania, and Monroe, Louisiana.

Longleaf pine commonly fails to reproduce itself satisfactorily in a reasonable time, even when seed trees are adequate, when hogs are excluded, and when seedbed, moisture conditions, and other factors are favorable. The cause for this appears to be due to rodents and birds, which feed on the seeds and leave no surplus adequate for regeneration of the forest, except in years of bumper crops, which may occur not more than once in a decade. It is becoming increasingly apparent that successful natural regeneration of longleaf pine is in large part determined by a number of biotic factors. Intelligent control measures can not be undertaken until a comprehensive study is made of the forest wild life, their feeding habits, the numbers present in natural populations under different environmental conditions, natural enemies, etc. All of this indicates that the final solution of natural reproduction in longleaf pine necessitates forest biological studies.

2. Methods of Cutting

Two intermediate cutting plots aggregating 19.5 acres were established near Urania, Louisiana, in a second-growth stand of loblolly pine mixed with shortleaf pine and hardwoods. The stand averages 25 to 30 years old, and is exceedingly variable in density. Large residual pines and hardwoods, left behind at the time of the original logging about 30 years ago, are scattered through the stand. This condition is very common in the shortleaf-loblolly-hardwood type in northern Louisiana. A cutting was made in this stand to test the commercial practicability of combining an improvement cutting or thinning with a reproduction cutting.

The stand-improvement measures consisted of (1) killing or felling large, worthless trees that suppressed valuable young pine or hardwood; (2) thinning the denser portions of the stand by freeing crop trees; (3) cutting mature and over-mature merchantable pines and hardwoods for sawlogs and making room for pine reproduction; and (4) felling or girdling diseased, dying, and exceedingly crooked or knotty trees to give more room to sound, thrifty crop trees. In making this cutting, an average of three cords of pine pulpwood and 800 board feet, Doyle rule, of sawlogs per acre were removed. A careful record was kept of each item of cost and return, based on current wages and prices. The stand was left in greatly improved condition and an operating profit of $2.06 per acre was made, with a stumpage realization value of $5.76 per acre. The tract was adjacent to a gravel road, and smaller profits would naturally be realized from less accessible areas. It was found, however, that stand improvement can be carried on at a small profit, even when the amount of merchantable material removed is small.

The Station assisted the State Extension Forester of Louisiana in drawing up cutting regulations that will insure continuous production of pine pulpwood from the loblolly-shortleaf pine forest area centering around a large pulp mill in northern Louisiana. The regulations as drawn up were accepted by the pulp company with only slight modifications, and will become effective January 1, 1934. The regulations are as follows (all diameters refer to stump diameters at 8 inches from the ground):

General rule: Leave one pine seedtree 11 inches or larger on each quarter-acre. Trees should be selected for seed production as indicated by large crowns and/or abundant old cones. Loblolly pine should be favored for seed trees.

Supplementary rules for different kinds of stands:

1. Irregular stands with a wide range of intermingled diameter classes and uneven crown canopy:

In the class from 7-10 inches, leave trees of this class so they will be not more than 18 feet apart or not less than 34 trees of this class per quarter-acre (50 trees where reproduction is poor and 25 trees where reproduction is good.).

2. Stands in which a narrow range of diameter classes predominates and the crown canopy is relatively even as in even-aged old-field stands:

a. In stands averaging 12 inches or more leave all trees below 10 inches.

b. In stands averaging 9 inches leave at least 34 trees per quarter-acre, spaced not more than 18 feet apart, in the 7 to 11 inch class.

c. In stands averaging 6 inches or less, no cutting should be made.

As an example of the results secured by leaving an adequate growing stock according to the above regulations compared with the common practice of cutting to about a 6-inch diameter limit, data on a typical well-stocked stand from north Louisiana are presented.

The volume of the stand is 19.2 cords of pulpwood per acre. Cutting under present practice (6-inch diameter limit) would remove 19.05 cords, which at the rate of 50 cents per cord net is worth $9.52. The 0.15 cord left on the acre would increase in the next 10 years to but 0.95 cord worth 48 cents. Cutting according to the above recommended regulations, 4.2 cords, worth $7.10, were removed. This leaves 5.0 cords which would increase, in the same period, to 9.4 cords. 4.4 cords worth $2.20 could then be cut at each 10-year period. Discounting both these expected returns back to present values (at 4 percent compound interest) gives, for the 6-inch diameter limit cutting system, a present value for the cut 10 years hence of 32 cents, and for the present value of the series of cuts coming each 10 years, $4.58. The total present value of the stand under the 6-inch diameter limit cutting system, is, therefore, $9.52, plus 32 cents, or $9.84. The total present value of the stand under the regulated cutting, however, is $7.10, plus $4.58, or $11.68, equivalent to an interest return on the investment of 6.5 percent, or an average annual return of 17.4 cents more per acre than under the 6-inch diameter limit system. Furthermore, with regulated cutting stand-improvement would be rapid, so that values up to $20 or more per acre would accrue, whereas no such improvement would be possible under the clear cutting system.

3. Thinning

Three new series of thinning plots were established near Cogdell, Georgia, in second-growth slash pine stands. Twenty 1/10-acre plots were established in 12-year-old slash pine, uniformly stocked and ranging in density from 1,370 to 8,190 trees per acre, or 1,070 to 5,980 trees above 0.6 inch in diameter breast high. Eight 1/10-acre plots were established in 8-year-old slash pine ranging from 1,180 to 8,730 trees per acre. Twelve 1/10-acre plots were established in 10-year-old slash pine with a density of 670 to 3,500 trees per acre. The purpose of these plots was to determine the effect of various degrees of thinning on dense, young, even-aged slash pine stands. These plots mark an advance in thinning sample plot technique and include improved methods of comparing different marking systems. The new technique represents a radical departure from the older method of using paired plots, treated and untreated.

In order to obviate the necessity of pairing plots (with its concomitant expense of time and money used in finding and comparing prospective plots), the new method eliminates original differences from the comparisons. For a given species age and site variations in original stand conditions include differences in average diameter, density of stocking, diameter dispersion, and sampling variation.

A system of marking for thinning future turpentine stands that allots to each tree a minimum space seems at present to be both practicable of application and promising of high yields of naval stores. The Cogdell plots were marked to test two modifications of this system.

One series of plots was thinned to 200, 300, and 400 trees per acre, together with a check plot. For the three densities, respectively, a minimum average spacing of 15, 12, and 10 feet was given to each tree. An effort was made to get the full number of trees on each plot, even at the expense, in some cases, of sacrificing a slightly better tree to retain two slightly poorer trees.

A second series of plots was thinned to 100, 300, and 500 trees per acre and unthinned check plots established. In this case no sacrifice of quality of tree was made, but rather, if necessary, a sacrifice was made in the total number of residual trees. In the third series, eight plots were thinned to 300 trees per acre and the two methods were compared.

The necessity of isolation strips was also tested. One series was established without isolation strips, while on another series strips 1/3 and 1/2-chain in width were left between sub-plots.

Two new series of thinning plots were laid out in second-growth longleaf pine in Baldwin County, Alabama. These plots were arranged in two Latin squares of sixteen 1/10-acre sub-plots each. Three degrees of thinning and a check sub-plot are replicated four times in each plot. Spacings of 200, 300, and 400 trees per acre used. The object of the thinnings is to hasten and increase the yield of naval stores.

Three new thinning plots in loblolly pine mixed with shortleaf pine and hardwoods were established near Urania, Louisiana. Two of these, aggregating 19.5 acres, included other treatment than simple thinning and are discussed under "methods of cutting." The chief feature of these thinnings is that they were made by the "crop tree" method. This involves the careful selection of the best trees, the "crop trees," or those that it is desired to grow to maturity. Having selected these "crop trees," all trees offering serious competition to the chosen individuals are removed. The emphasis is thus logically placed on the trees to be left and not on the trees to be cut. This represents a departure from previous practice, when the poorer trees were cut to benefit the stand as a whole with no special effort made to benefit individual trees. The new thinnings were also made heavier than in the past, since experience has shown that light and medium thinnings, which removed only the poorer trees, have very little, if any, beneficial effect on the residual stand.

A new thinning plot in loblolly pine near Urania was established after the crop trees had been pruned to 17-1/2 feet. The plot has an aggregate area of one acre and the stand is 11 years old. Of 558 trees per acre in the original stand, 284 trees were left.

4. Stand betterment

A series of 15 ten acre plots was established on the Choctawhatchee National Forest to determine the effectiveness of release cuttings in the longleaf pine scrub oak type. Here the problem is to bring the pine seedlings up through an overtopping stand of scrub oak. Removal of the oak is necessary if a reasonable stand of pine is to be obtained. Release was effected on the several plots by use of axes, machetes, brush-hooks, and poison, respectively. Each tool was used to free the pine for distances of 3 to 6 feet. The plots were established in duplicate.

Greeley Pasture, near Urania, Louisiana, which has been under lease by the Station for 10 years, was gone over systematically and all hardwoods interfering with pine were cut on 1,250 acres, leaving 250 acres untreated as a check. This will serve both as a test of the economic practicability of such a cutting and as a test of the extent to which such a measure will affect the residual pine.

Forestation

The outstanding accomplishment in this field during 1933 was the completion by Wakeley of a manuscript on "Artificial Reforestation in the Southern Pine Region."

The Station's loblolly pine spacing plantations, established in the spring of 1923 at Bogalusa, Louisiana, were reexamined in 1933, after 10 full growing seasons in the field. These plantations cover four acres, one each at spacings of 5 x 5, 6 x 6, 6 x 8, and 8 x 8 feet. The 6 x 8 plantation was established with wild stock of uncertain age, and is not comparable with the other three plantations, which were established with 1-year-old nursery stock. At the end of 10 years in the field the three plantations established with comparable stock showed no appreciable difference in height, but the closer spacing had caused marked differences in diameter growth and in extent of dying of lower branches, together with slight differences in diameter of twigs and in recovery from injury by Nantucket tip moth. The exact figures are given below:

Spacing (feet)	5 x 5	6 x 6	8 x 8
Average height (feet)	20.96	19.66	19.91
Average diameter breast high (inches)	3.39	3.54	4.02
Average height to first live branch (feet)	7.14	5.58	4.62
Average diameter largest dead twig 1/	0.71	0.75	0.81
Average recovery from tip-moth injury	2.79	3.40	3.56

1/ On basis 1 = good, 5 = poor.

So far as quality of products is concerned, these results point to the desirability of close spacing for loblolly pine. Even the slower growth in diameter at 5 x 5 foot spacing is preferable to the rapid rate at 8 x 8 foot spacing, because of the difference in coarseness of the grain.

The remeasurement of these 10-year-old plantations yielded valuable information on the size of samples needed for comparisons between treatments and will enable the Station, in the future, to lay out and remeasure greater numbers of plantations than heretofore was felt feasible. The Forest Service has recently expanded its forestation activities in the South and plans to plant between 60,000 and 100,000 acres of cut-over longleaf pine land on National Forests near Alexandria, Louisiana. A 10-million tree nursery is being established nearby.

This expansion means both increased opportunities and increased responsibilities for the Southern Station. A tract of approximately 1,000 acres is being set aside from the National Forest for the Station's use in experimental planting and nursery space is likewise to be set aside for its work. This new work in nursery and planting studies is designed to fill two needs. One is for the solution of forestation problems common to the entire southern pine region, particularly those requiring long periods of time and special technique; the work already done at Bogalusa has focussed attention on, and laid the foundation for, these studies. The other need is for the solution of immediate local nursery and planting problems confronting the National Forests. The problems common to the entire southern pine region include, (1) improvement of tree percent (number of 1-year-old trees produced per 100 sound seeds sown) in the nursery, (2) fertilizer studies (including soil crops), (3) studies of seed source, (4) spacing, (5) choice of species for different sites, (6) mixture of species, and (7) conversion of areas of scrub oak to pine. Problems of immediate interest involve: (1) season-of-sowing studies; (2) studies of mid-season root pruning in the nursery; (3) recognition and control of nursery pests; and (4) studies of standards of performance in planting, such as minimum care and maximum speed of planting, which will give consistently good results. A feature of the new work will be a check on the results of nursery studies by means of field plantations of stock grown under different treatments.

During the planting season of 1932-33, Gemmer devised a one-man planting tool for use on the brush fields of the Choctawhatchee National Forest. The need for a special planting tool in this forest type has been demonstrated time and again over a period of six years during which time the mattock, several types of planting-bars, and the open-hole shovel method was tried. The problem was to make a clean opening at least 10 inches deep in the loose sands and oak roots. To do so efficiently implies that the opening be made with no more than two blows. This requires a tool of considerable weight, well balanced and so shaped that it will slide between roots rather than sever them. The Choctawhatchee tool consists of a tapered blade 10 inches long, 2 to 3 inches wide, 3/4 inch thick, with a stock 5 inches long, and a pistol grip. It weighs slightly over five pounds. The sharpened point is of tempered steel.

So far this tool has proved successful for planting under conditions for which it was designed. Whether it can be used generally is not known but tests will be made on future planting operations by the Station in several diverse forest types.

Measurements

Southern Pines

The recently established forest management plots at Urania have furnished a basis for the construction of local pulpwood and cubic-foot volume tables for second-growth loblolly pine. It has also been possible to establish conversion factors and ratios between diameter breast high and number of bolts of pulpwood, volume in cords and in cubic feet, time required to fell and buck up, etc. A table showing the correlation between those various items is of value in helping to determine the size of tree most profitable to cut for pulpwood and in furnishing specific reasons why small trees should be left for further growth.

Among the many interesting relationships developed are the following:

1. There is a striking increase in the number of bolts per tree with increase in diameter in the smaller size classes, especially in trees between 4 and 6 inches in diameter.

2. The cutting of small trees into pulpwood results in a tremendous waste of stemwood that rapidly becomes of merchantable size with relatively small increase in size of tree.

3. It takes nearly four times as many 4-inch trees as 5-inch trees to make one cord; and between 5 inches and 7 inches, the number of trees per cord drops rapidly, indicating the inadvisability of cutting small trees for pulpwood. Small increases in size of trees result in relatively large increases in the amount of cordwood per tree.

4. The increase in cubic volume with increase in diameter is very large in the small trees and becomes gradually smaller in the larger diameters. Here also the waste and inadvisability of cutting small trees is indicated.

5. The output in cords per hour for two men reaches a maximum for 7-inch trees and, except for the 4-inch trees, does not vary greatly. This was an unexpected finding, as it was thought that the output would increase regularly up to at least the 12-inch diameter class.

6. The output in peeled cubic feet increases consistently with increases in tree size.

7. The actual cubic contents of solid wood in cords made up of small bolts is not as great as in cords made up of large bolts. There is a pronounced increase in volume of peeled wood in a cord with increase in diameter of the trees from which the pulpwood is cut.

Data on second-growth loblolly pines cut for pulpwood - Urania, Louisiana; age of stand, 25 - 30 years.

D.B.H.	Total Height	Number of 4-1/2 ft. pulpwood bolts	Actual used length	Percent of total height actually used	Number of trees per cord	Volume in cubic feet, including bark of pulpwood	Volume in cubic feet, peeled pulpwood
	Feet		Feet				
4	38.5	1.0	4.5	12	178.0	0.5	0.3
5	43.0	3.5	15.7	36	46.2	1.8	1.3
6	46.5	5.5	24.8	53	26.5	3.4	2.5
7	49.8	7.0	31.4	63	18.7	5.5	4.0
8	52.6	8.0	36.0	68	14.7	8.1	6.1
9	55.1	8.7	39.3	71	12.3	11.0	8.4
10	57.1	9.2	41.6	73	10.6	14.2	11.1
11	58.6	9.6	43.1	74	9.4	17.6	13.9
12	59.3	9.8	43.9	74	8.5	21.1	17.0

D.B.H.	Time to fell and buck up (minimum for two men)1/	Output in no. of cords per hour (two men)1/	Output in number of peeled cubic feet per hour (two men)1/	Number of peeled cubic feet per cord	Basis number of trees
4	1.1	.25	13.6	53.4	52
5	2.3	.47	28.3	60.1	220
6	3.5	.54	35.7	66.3	161
7	4.8	.58	41.7	74.8	72
8	6.3	.54	48.4	89.7	39
9	7.9	.51	53.2	103.2	19
10	9.6	.49	57.8	117.8	8
11	11.4	.47	61.1	130.7	7
12	13.1	.45	64.8	144.5	5

1/- Allowing 20 percent of effective working time for rest, etc.

NOTES: Pulpwood was cut to an elastic top diameter inside bark averaging 3.5 inches, but not less than 3.0 inches. The actual average top diameter inside bark obtained ranged from 3.2 inches for 4-inch trees to 4.5 inches for 12-inch trees.

In the above table, one cord is composed of 5 "pins," each 6.2 feet high (a "pin" is an upright, hollow, crib-like structure in which each layer of 2 bolts is laid at right angles to the layers immediately above and below). One cord of 5 pins was found to be equivalent to solid stacking of small or medium-sized bolts into a pile 4 ft. high and 8 ft. long. The bolts are 4.5 ft. long, hence the cords in the table each contain 144 cu. ft. instead of 128 cu. ft., as in a standard cord. The pulpwood was cut and piled in accordance with local requirements and custom.

Hardwoods

During 1933, the field work of the growth and yield study of red gum in pure, even-aged stands was completed. Twenty-four growth and yield plots were established in fully stocked red gum stands in the bottoms of the coastal streams of South Carolina, Georgia, Florida, Alabama, and Mississippi, bringing the total plots for this study up to 98. An attempt will be made to ascertain whether the growth rate of this species is significantly different in these smaller bottoms from that in the Delta of the Mississippi River.

Measurements were taken on 80 second-growth red gum trees to obtain data from which a red gum volume table could be prepared. The total number of trees measured for the red gum volume table is 159, which is believed sufficient for the construction of a satisfactory table.

Since much of the bottomland hardwood forest area is logged on a selective logging basis, the outstanding growth problem of this region is the rate of growth of these stands. To help solve this problem, it is planned to make a study of the rate of growth of selectively cut bottomland hardwood stands. As a preliminary test, one permanent sample plot 12 acres in area was established in an area that originally had a stand of approximately 12,000 bd. ft. of virgin timber per acre. About 6,000 bd. ft. per acre were removed 8 years ago. The average annual growth per acre on the residual stand since cutting has been 172 bd. ft.

Further work on this project involves the establishment of additional plots in selectively cut stands of different forest types and in stands which have had different original volumes per acre and varying amounts left after cutting. By continuing the work in this manner, the conditions giving maximum growth after selective logging will be determined.

Naval Stores

General

During the last few years the naval stores belt of the South produced approximately 66 percent of the world's supply of turpentine and rosin. Domestic industries consumed, on the average, 54 percent of the turpentine and 44 percent of the rosin, leaving a large balance for foreign export. In 1931, the naval stores produced from longleaf and slash pine of the Southern States totalled 500,000 barrels of turpentine and 1,655,000 barrels of rosin. This closely approximates the average yearly production during the preceding 10-year period. Based on typical stands at the present time, it requires only about 14,000,000 acres to produce annually this volume of naval stores. The problems involved in perpetuating the forests on which an industry of this size and importance are dependent are many and varied. Their solution is of vital importance to the industry, if it is to continue to supply the world with these necessary products. The Southern Station is working on a number of these naval stores problems and is centering its field investigations at Lake City, Florida. The major naval stores studies include a determination of the relations of tree gum yield to (1) methods of chipping; (2) tree factors; (3) weather; (4) fire; and (5) management.

1. Methods of Chipping:

(a) Height of streak: Tests have demonstrated the feasibility of continuously working turpentine faces with narrow streaks (1/4-inch wide) for a period of at least 8 years without a serious decline in yields, whereas ordinary commercial work shows a decline in yield of 5 percent or more annually and the trees are worked out in 5 or 6 years. With narrow streaks, 8th-year yields from slash pine were 19 percent less than the first year and only 6 percent less in the case of longleaf. High sustained yields and two or more extra years of work per face may be realized from chipping narrow streaks. This represents a net gain in yield per face of 20 to 50 percent and an extension in the workable life of the timber. Additional tests are needed in other parts of the naval stores region to substantiate these results.

(b) Back-facing: A point of very real interest to operators and timber owners is the relative yields to be expected from working the first and second sets of faces. Several tests in slash pine stands have consistently shown that slightly greater yields may be obtained from the second set of faces than from the first. However, the trees are usually at least an inch larger in diameter when back-faces are cut than when the front or first faces were installed. The yield from faces on previously unworked trees is only 70 to 85 percent as much as that from trees of the same size already worked with one set of faces. This serves as a basis for determining lease prices. Additional tests are needed for longleaf pine.

(c) Tin raising: Methods of raising and attaching tins are extremely important, not only as they affect the production of naval stores, but also as they contribute indirectly to loss from insects, rot, and windthrow. Current experiments are not as yet complete and few conclusions can be drawn at present. So far, however, the trees with tacked tins show up to slightly better advantage than those where tins were inserted in deep cuts. When deep cuts are made for attaching tins, the decline in yield over a 5-year period in slash pine amounts to 30 percent, whereas when tins are tacked two tests showed a decline of 3 percent and 19 percent, respectively, and a third showed a gain of 3 percent for a 5-year period. Similar tests in longleaf timber with deep cuts showed a 32 percent loss in 5 years as contrasted with a 12 to 15 percent loss with tacked tins.

Tacked tins also proved to be a factor in reducing windbreak losses. Where heavy work had been practiced a loss of over 8 percent resulted from a single hurricane, in contrast with a loss of 0.33 percent where tins were tacked.

(d) Interval of chipping: A preliminary experiment was completed in 1933 on the effect of frequent chippings on gum yields and on mortality of trees. It was shown that too-frequent chipping tends to decrease gum yield by increasing dry-facing. The percentage dry-faced at the end of the second season of work was 41 for 6 chippings per week, 30 for 3 times, 13 for twice a week, and no dry-facing for once-a-week chipping. The period of the experiment was 1931 and 1932, two very dry years, which, no doubt, augumented the drain on the timber from frequent chipping. A progress report covering these preliminary results has been prepared. Additional studies will be initiated in 1934.

2. Tree factors:

Considerable progress has been made in a study of the relation of such factors as growth rate, age, and size of crown to gum yields. When completed the data obtained from this study will supplement the tables showing the relation of gum yield to the diameter of the tree by applying a correction factor based on size of crown. This will give a more accurate estimate of gum production than when only diameter of the trees is considered. The knowledge of what gum yields may be expected from a tract of timber is as important as the knowledge of the volume of other forest products and is already used by the Forest Service in making appraisals for the purpose of establishing cuppage rates on the National Forests. The small yields obtained from working trees under 9 inches in diameter have shown that it is doubtful whether there is any profit in turpentining such trees, except when prices are high. This has been recognized by progressive operators and factorage houses who are discouraging the chipping of trees under a 9-inch limit. The naval stores marketing agreement has also included the 9-inch limit.

A manuscript containing the results of the 1926-33 tests on methods of chipping and tree factors has been prepared by Wyman under the title, "Turpentining Tests in Slash and Longleaf Pine." This is the second major manuscript from the Station dealing with naval stores research, the first having been published as Department of Agriculture Technical Bulletin 298, in April 1932, entitled, "Experiments in Naval Stores Practice." It is planned to have the second manuscript in shape for publication during 1934.

3. Weather relationships

Weather and gum yield relationships are not generally understood by the naval stores industry and the vagueness of the subject has given rise to various practices and rules of thumb that do not always result in maximum gum yields commensurate with health and vigor of the timber. The influence of different weather factors is difficult to evaluate, because of the combined play of several factors at any one time. Following a comprehensive gathering of field measurements of yields and weather data special methods were developed for analysis of the data. The analysis of these data was completed in 1933 and it is now in manuscript form as a proposed Government

Bulletin under the title, "Variations in Naval Stores Yields Associated with Weather and Elapsed Time Since Chipping." Some of the conclusions are as follows:

1. Ninety percent of the yield variation from day to day and week to week is traceable to three weather factors: (1) air temperature, mainly; (2) soil temperature; and (3) evaporation to a smaller degree. Higher temperatures and greater evaporation were accompanied by increases in gum yield.

2. The general belief that rain falling on the freshly chipped surface causes it to cease running gum is erroneous. Lower yields often accompany rains, but this is attributed to lower temperature.

3. The close association between air temperature and naval store yields permits an estimation of the effects of climate on yields for different parts of the naval stores belt. For instance, the higher temperatures and longer growing season of Florida and Georgia are more favorable for naval stores than the conditions of South Carolina and North Carolina.

4. Closely tied in with favorable weather conditions for rapid rate of naval stores yields is the length of time a tree will yield after each fresh wounding. During hot weather (82 degrees Fahr. average temperature for a 24-hour day) longleaf pine exudes 90 percent of its capable yield in 2 days following chipping, whereas slash pine requires 4 days to run the same proportion of its capable yield. During cooler weather it takes more time for the tree to "run out" of gum. However, unless the average temperature falls below 60 degrees Fahr., it is not worth while to allow either slash or longleaf pine more than 7 days between chippings. This has a direct bearing on the determination of the optimum interval between streaking for the two species.

5. Continuous year-round chipping is a serious drain on the vitality and yielding power of the tree.

6. The maximum flow of gum occurs about 9 o'clock in the morning; very little gum flows at night.

Drought effects: Definite data on the effect of a severe drought extending from September 1931 to July 1932 were obtained. On the experimental timber tracts the gum yield from slash pine in 1932 (the drought year) was 20 to 22 percent less than the average for the years 1931 to 1933. For longleaf the drought reduced yields 13 percent. Exceptionally heavy mortality accompanied this dry weather and the number of dry faces increased. Damage was accentuated in heavily worked stands, pointing to the need for light work under extremely dry weather conditions.

4. Naval stores and fire

In addition to the direct effect of fires on tree growth, the question of whether such fires influence gum yields as reflected in changes in the productivity of the soil has long been a matter of controversy. Advocates of complete fire protection claim that not only is the soil rendered less productive by repeated fires, which consume the organic matter, but that the soil becomes drier and more impermeable following the continued removal of the pine needle litter by fire.

Because of the frequent and widespread occurrence of woods fires in the naval stores region, the answer to this problem is important in the formation of forest management plans for naval stores forests. With this in mind a study of the effect of forest fires on the soils of the longleaf pine region was begun in 1930. The phase of the problem dealing with the changes in the chemical properties of the soil accompanying fire has been completed. Results based on a study of 8 representative soils of the region show that increases up to 15 percent in nitrogen and organic matter and increases up to 100 percent in calcium (lime) are associated with repeated fires. Moreover, the soils subjected to fire were consistently less acid than the soils protected from fire.

The importance of these changes in the soil to forest growth and gum yields is now being investigated. A series of greenhouse experiments has been started, in which pine seedlings are being grown in the soils in which the differences in chemical properties were found. In addition, a study is being made of the moisture relations and the permeability of the soils of burned and unburned areas. It is possible that these physical properties are equal to or more important than the chemical properties.

The naval stores and fire project, insofar as it relates to the soil, has been carried on in cooperation with the Florida Agricultural Experiment Station. During the 3-year period ending June 30, 1933, the Southern Station contributed to the salary of Dr. R. M. Barnette of the Florida Station. Because of curtailments of funds, the Southern Station was obliged to terminate this arrangement at the end of the fiscal year 1933. A manuscript covering the results of the cooperative project has been prepared by Heyward and Barnette, entitled "Effect of Frequent Fires on the Chemical Composition of Forest Soils in the Longleaf Pine Region."

Gum yields from trees growing on burned and unburned areas so far indicate that there is little difference in yields if the fire does not defoliate the tree itself or scorch the face. Additional studies are under way on the Olustee Experimental Forest to determine more exactly an answer to this question.

A study was made of the effect of crown defoliation by fire during 1933. Complete defoliation without accompanying trunk scorching caused a loss of 43 percent in gum yield compared to that of similar unscorched trees. Partial crown scorching caused a falling off in yield of about 20 percent. The study will be continued to determine how soon if at all, the trees recover from the fire.

5. Naval stores management

Numerous plots have been established to observe the results of thinning naval stores stands to various densities. The first tentative results of remeasurements in 1933 indicate the advantage of thinning early in the life of a stand (8 to 15 years) in order to obtain fast growing trees. In the 3 to 5 years following thinning, responses are relatively small for stands 25 years of age or older.

In the flatwoods area of the South (aggregating about 30 million acres), relative elevation, and hence drainage, determines to a large extent the rate of growth of the timber. As a rule the fastest growing timber is found on the better drained soils. During the past year measurements of the effect of poor drainage were made on slash pine in Georgia. Starting at the normal edge of a pond, it was found that with each foot rise in elevation (under similar density) there was an increase of 0.227 inch in average diameter of the stand. The benefits of 1 foot rise in elevation above the pond were equivalent to the response in accelerated growth that could be expected from a heavy thinning in a dense stand. Local differences of 1-1/2 ft. in elevation determine whether a tree stands in fairly well drained soil or intermittently to generally wet soil. A brief reconnaisance of the flatwoods region indicated that about 30 percent of the area is in ponds and swamps with stunted tree growth. Many shallow ponds now supporting slash pine and pond cypress might advantageously be drained by ditching, thereby increasing the growth rate of the timber.

Erosion-Streamflow

Since 1929 erosion-streamflow studies have been carried on by the Station in the Loessial Silt Loam Uplands of Mississippi. This entire region was covered rather thoroughly by an erosion survey made during 1930 but since that time more detailed studies have been concentrated near Holly Springs, Marshall County, Mississippi, in the northern portion of the State. The Holly Springs Branch of the Mississippi Agricultural Experiment Station has cooperated in these studies by furnishing land on which to work.

Owing to the fact that 10 to 25 percent of the total area of many counties in this region is in large, actively eroding gullies, special emphasis has been placed on the experimental planting of these denuded areas to trees and other vegetation as perhaps the most feasible method of reclaiming them and of preventing the spread of gullies into adjacent arable land. The surveys show that on the upland watershed of the Yazoo River, totalling about 3-1/2 million acres, there are more than 813,000 acres of abandoned farm land, on more than 300,000 acres of which exist large gullies that can best be reclaimed by reforestation. There is strong evidence to indicate that such extensive areas of gullied lands have an important influence on streamflow and floods and that the revegetation of these barren areas is needed to insure proper watershed protection.

Experimental planting of trees and other vegetation was done on gullied areas during the springs of 1931, 1932, and 1933 in order to determine the most effective and economical means of establishing a plant cover on eroded sites. In 1931 six areas of about one acre each were planted in Adams, Franklin, Carroll, Lafayette, Marshall, and DeSoto Counties. In 1932 and 1933 planted areas are located near Holly Springs. More than 20,000 trees have been planted to date, each of which is kept under detailed observation and examined and measured annually. The species planted include black locust, southern red oak, Nuttal or bottomland red oak, sweet gum, catalpa, sycamore, cottonwood, willow, mimosa, white ash, black walnut, sassafras, persimmon, shortleaf pine, loblolly pine, slash pine, Austrian pine, ponderosa pine, and red cedar. Studies have been made of planting stock, planting methods, and subsequent treatment such as cultivation, pruning, etc. Plowing along the tops of gully banks prior to planting and the use of temporary check dams of brush, wire and grass sod in the gully bottoms have also had a prominent place in these erosion control planting studies. Accessory soil-fixing vegetation used alone or in combination with the tree plantings include Bermuda grass, Dallis grass, common lespedeza, Johnson grass, Japanese honeysuckle, and kudzu bean.

Results to date show that the larger grades of 1-0 black locust, 1-1 shortleaf pine, and 1-1 loblolly pine planting stock have given best results. Thus, 87 percent of the grade 1 black locust (1-0) stock (average height 21 inches) survived the first growing season as compared with 62 percent of the smaller grade 3 stock averaging 8 inches in height. The data indicate that given favorable sites on which to plant, such as on soil fills behind check dams, the size of stock used makes but little difference. However, very depleted and often unstable soils comprise the bulk of the eroded sites on which trees must be established and it is on these situations that the larger, more vigorous stock has proved superior.

This superiority is often reflected in lower mortality during the second growing season as shown by the data from one area planted to black locust in 1931. Of the grade 1 stock, 100 percent survived the first season and 91 percent the second. In contrast only 84 percent of the grade 3 seedlings survived the first year and 34 percent during the second growing season.

In the spring of 1933, six sizes of 1-0 black locust seedlings ranging from 14 to 63 inches in height were planted on a variety of sites, to furnish additional comparisons. The plantings are noteworthy inasmuch as an extremely large class of planting stock was planted successfully by the ordinary dibble method and with little extra expenditure of labor. This was made possible by very severe pruning of the root systems which in the case of 5 to 6 foot seedlings were cut back to a length of only 6 inches without producing any apparent ill effects on subsequent survival and growth.

Cutting back large black locust seedlings at time of planting is often suggested as a means of getting increased growth from the sprouts. This is being studied but the results to date do not support this theory. Seedlings cut back to the ground have consistently failed to attain the height growth of check seedlings, and on one area, suffered about 10 percent greater mortality during the first growing season. One and two-year-old black locust have reacted similarly when cut back to the ground.

Owing to the fact that black locust produces root suckers in abundance, the use of root cuttings has been advocated as a means of propagating the species and is being tested. Preliminary results from small scale plantings indicate that root cuttings are not a very dependable type of planting material since many fail to produce sprouts at all and those that do, fail to survive satisfactorily.

Another important phase of the erosion-streamflow project has been the determination of the soil and water losses from the principal classes of land in northern Mississippi and a study of the relation of such losses to floods and stream behavior in general. Run-off and erosion studies have been under way at Holly Springs since the summer of 1931. Small study plots, 3 x 12 feet in size, were established on uniform 10 percent slopes on similar soils under various types of land use. A description of this study along with the results for the first 14 months period appeared in the Station's last annual report. The data for the 2-year period exhibit little deviation in trend from the results reported last year showing conclusively that run-off and erosion from soils protected by a forest or grass cover is extremely small compared with the huge losses from cultivated or bared soils. For 103 rains totalling 131 inches of rainfall, the average percentage of rainfall which ran off was less than half of 1 percent from mature oak forest and from an unburned broomsedge grass cover as compared with 52 percent from barren abandoned land, 32 percent from a cultivated cotton field (rows on the contours) and 39 percent from a cotton field with the rows running up and down the slope. A black locust and a bermuda grass cover are also exceedingly effective in preventing run-off. An average of only .93 percent of the rainfall ran off the former class of land and 1.37 percent off the latter. Soil losses from the various types of cover are in keeping with the above data. Thus the oak forest plot lost in 2 years .07 pounds of soil, the broomsedge plot .30 pounds, Bermuda grass plot .51 pounds, the black locust plot 1.68 pounds, scrub oak plot 1.09 pounds, the barren plots 274.96 pounds, and the cultivated plots 122.60 and 331.47 pounds respectively. A single rain of 4-1/2 inches washed soil from the latter plot at the rate of 21 tons per acre.

The effect of annual fires on erosion and run-off is also being studied in connection with the study of run-off from the oak forest and broomsedge plots. In 1931 duplicate plots were established in these two types of cover and one plot in each case was burned in mid-March, 1932, and again in late

February, 1933. Preliminary results show that each of the two fires markedly increased run-off and erosion from both types of cover. In the case of the burned forest plot less than 1 percent of the rainfall ran off during the period preceding the first burn. More than 3 percent of the rainfall ran off after the first burn and 10 percent after the second. Following the second fire, run-off from the check plot was only .72 percent of the rainfall. After the second burn more than 18 percent of the rainfall ran off the burned broomsedge plot as compared with less than 2 percent from the check plot. Soil losses as a result of the second fire were at the rate of 1,669 pounds per acre annually from the forest plot and 1,587 pounds per acre from the broomsedge plots as compared with negligible erosion from the check plots. It is planned to carry on the fire studies for 5 or more years.

Another project, undertaken in 1932, is the measurement of run-off and eroded soil from 2 small gullies on which control measures involving the use of trees and other vegetation will be applied in the spring of 1935 after a preliminary run. The erosion control planting studies will be continued. The fact that a national forest unit is being established near Holly Springs will make federally owned lands available for experimental work and will assure greater permanency to the Station's studies.

Financial Aspects of Private Forestry

Second-growth stands or cut-over areas now make up over 90 percent of the forest land of the South. If these forests are to be kept productive and if they are to be put under sustained yield forest management, forest owners, both farmers and large land-owning companies, must be furnished with reliable information of the financial possibilities involved. The Financial Aspects of Private Forestry project will obtain this information and make it available to landowners.

The Financial Aspects studies include three principal lines of investigation: (1) county studies; (2) case studies of private forestry operations; and (3) land use studies.

A report covering a county-wide study of Union Parish, Louisiana, was completed in December, 1933. This is one of 11 similar county studies, made in 8 southern states, representing the principal pine timber types of the South. These studies have shown conditions generally favorable to private forestry practice. Union Parish has over 60 percent of its area in forest and about two-thirds of the forest land is in farm woodlands. Studies of individual farms there show that very few farmers practice forestry. However, in an average farm woodland of the parish, it was found that the well-stocked pine stands are growing at the rate of over 500 board feet per acre per year and that the average annual growth for the whole farm woodland of the parish is over 200 board feet per acre. The possible annual income from the present well-stocked stands from sale of stumpage and pulpwood is $2.47 per acre per year and from the whole woodland is $.71. The cost of taxes, fire protection, and forest management per acre per year averages $.31 for the well-stocked areas and $.23 for the whole woodland. This differential between cost and income from forest products makes profitable forest management possible.

Reports of two case studies in the shortleaf-loblolly pine-hardwoods type, one for a large forest property and the other for a small tract, have shown that sustained yield forest management in that type is feasible. Both companies have accepted the recommendations made by the Station and have begun selective logging on a sustained yield basis. A follow-up study of costs and returns will be made by the Station.

Another major case study has been initiated in second-growth slash and longleaf pine stands in southern Georgia, where intensive fire protection has been under way for 10 years. This study will bring out the financial possibilities of forests managed primarily for naval stores. The project is being undertaken in cooperation with a large naval stores operator, who has agreed to set aside an area of 500 acres and manage it according to best known practices. All costs and returns will be kept separate for this particular area.

In the Lower Piedmont region of Georgia, where land abandonment for agriculture has created a serious problem of land use, a study has been undertaken in six typical areas to determine the part forestry should play in their economic rehabilitation. This study is being made in cooperation with the Bureau of Agricultural Economics, the Regents of the University of Georgia, and the Georgia Forest Service. The field work on this project has been completed and a report is now being prepared covering the part that timber growing can play in maintaining and improving economic conditions and in preventing and stopping soil erosion.

The Lumber Code, with its Article X requiring conservation of forest resources, has focused the attention of lumbermen on selective logging and sustained yield management. Interest in and demands for facts regarding financial possibilities of private forestry have increased greatly. It is expected that the Station's Financial Aspects project will be drawn on heavily to meet this situation.

New Public Domain

Since the Station's last annual report giving data on the extent of tax-delinquency and reversion in the Gulf States as of January 1, 1932, two tax-years have passed, adding huge areas to the already large total of the "New Public Domain." Estimates as of July 1, 1933 are as follows:

ate	Total land area	Total forest land area	Total land area reverted	Total forest area reverted	Total land area delinquent but not reverted	Total forest area delinquent but not reverted	Percent of total forest area: Reverted	Percent of total forest area: Delinquent	Percent of total forest area: Involved in delinquency
	-----All areas in thousands of acres----						-----Percent------		
a.	35,111	23,600	1/ 11,800	1/ 7,670	1/ 5,075	1/ 3,300	32	14	46
.	37,584	22,872	(2/)						
a.	32,819	21,680	80	8	200	20	(3/)	(3/)	(3/)
ss.	29,672	18,293	1,250	750	850	510	4	3	7
.	29,062	18,903	2,708	1,354	900	450	7	2	9
k.	33,616	22,000	3,800	2,340	1,000	670	17	3	20
la.	4/ 4,760	4/ 4,279	5/ 600	540	175	157	13	4	17
x.	4/ 17,231	4/ 12,624	920	4/ 690	220	165	6	1	7
t	219,805	144,251	21,158	13,352	8,420	5,272	15	4	19

1/ Landowners do not consider their lands reverted to State Title, but believe they can retain title through legislative tax-adjustments. State's title questionable. Same statement applies, with less force, in all southern states.

2/ No reverted land in Georgia.

3/ Less than 0.5 percent.

4/ Includes only eastern portion of State, within limits of pine type.

5/ Title passes to county; this figure for entire area of commercial and non-commercial forest land in State.

These data are based on the best available estimates for the states of Georgia, Alabama, Oklahoma, and Texas, and on rather definite figures for the States of Florida, Mississippi, Louisiana, and Arkansas. The total represents an increase since January 1, 1932, of more than 4,800,000 acres in the total reverted area, and of 890,000 acres in the total delinquent area, indicating the increasing seriousness of the problem in these states. 13.5 percent of the total land area in the South is involved in tax-delinquency, and 18.6 percent of the forest area.

Field work in Arkansas was completed on June 1st, with two counties studied during 1933 - Johnson County, typical of the oak-pine type of the Ozark Mountains, and Lee County, typical of the bottomland hardwoods type of the Delta. Previous to 1933 three other Arkansas counties had been studied. These were Drew, Little River, and Washington Counties.

As of March 1, 1933, Johnson County showed the following tax status (total area 432,000 acres):

Tax status	Acres	Percent of total area
Reverted area	29,382	6.8
Delinquent for 1930 taxes	24,026	5.6
Delinquent for 1931 taxes	40,411	9.3
Total	93,819	21.7

As of May 1, 1933, Lee County showed the following tax status (total area 384,640 acres):

Tax status	Acres	Percent of total area
Reverted	29,736	7.7
Delinquent for 1930 taxes	65,765	17.1
Delinquent for 1931 taxes	52,837	13.7
Total	148,338	38.5

Assistance on field work in both these counties was provided by the Arkansas Agricultural Experiment Station (2 men in each county).

A report has been completed covering briefly the general conditions of physiography, industry, and finance of the State of Arkansas, together with a resume of tax legislation, of the method of obtaining field data, and of the general delinquency situation. Detailed reports on the counties studied are in progress. It is planned to complete all work in Arkansas by June 1, 1934.

Mississippi has been tentatively selected as the next state to be studied and field work will be inaugurated there as soon as the Arkansas reports are completed though not on the same basis as used in Arkansas. As a preliminary step in Mississippi, detailed data have been obtained on extent and location of tax reversion by abstracts from the records of the State Land Office. These data show two definite centers of excessive delinquency - one in the southeastern Mississippi longleaf pine belt and the other in the Yazoo Delta. Two minor concentrations occur - one in Choctaw, Chickasaw, and Webster Counties, in east central Mississippi, and the other in Franklin, Lincoln, and Amite Counties in southwestern Mississippi. Northeastern Mississippi shows very little tax reverted land. The counties to be studied intensively in this state have not as yet been finally selected, but it is planned to obtain basic data on location and extent of delinquency in Sharkey County (Yazoo Delta), Choctaw County (Shortleaf-Loblolly Pine Type), and Wayne County (Longleaf Pine Type).

Comparable tax data on Louisiana have been supplied by Dr. R. L. Thompson, Department of Economics, Louisiana State University. Concentrations of excessive reversion in this state occur chiefly in the longleaf pine belt of southwestern Louisiana and in the Delta, although the reversion in the latter region is scattered, some parishes having none or very small reversion, while in others the tax reverted areas are very large. One parish has nearly one-third of its area already in state title through reversion.

Forest Survey

Until October, 1933, the work of the Forest Survey was carried on by a field force of two to four 3-man crews and a computing force of two persons. The analysis of the Survey data of the bottomland hardwood unit of Mississippi was completed in 1933 and the first draft of the final report prepared. Field work in the shortleaf-loblolly pine-hardwood unit of northern Mississippi, embracing an area of approximately 6,000,000 acres, was finished in April, 1933, and 1,280,000 acres in the central Mississippi pine-hardwood unit were surveyed before active field work was concluded in June.

During the latter part of August and September plans for the expansion of the Survey organization were made and in early October new men to fill positions under emergency fund appropriations were recruited. On October 18th, fifteen men in the Junior Forester, Associate, and Assistant Timber Expert grades were appointed as Technicians. These men formed the nucleus of the expanded survey organization and were sent to training camps for intensive training in survey field methods. A training camp was established in southern Mississippi for the Technicians who were to be assigned as chiefs of the survey crews in the naval stores region. The training camp for 6 crew chiefs in the bottomland hardwood region was located at Lake Providence, Louisiana. These training camps were continued for approximately 3 weeks. Shortly before the camps disbanded and before the beginning of active field work, a number of crew men were sent to the camps for a few days' preliminary training. Later the field force was recruited to make up 14 crews of 3 men each. Field work in the bottomland hardwood region was begun in the north Louisiana Unit in November with six 3-man crews. This unit embraces the Louisiana bottomlands lying west of the Mississippi and north of the Red River. Field work in the naval stores region was begun in November in northeast Florida and southeast Georgia, with four 3-man crews in each state. Plans are being made for the expansion of the Survey to the Tennessee River Basin. This work will be done in cooperation with the Appalachian Forest Experiment Station and the forestry division of the Tennessee Valley Authority. Work will start in the Norris Dam Watershed, containing 1,700,000 acres.

The expansion in field personnel of the Survey has necessarily been accompanied by an increase in the office staff sufficient to keep computations in line with the progress of field work. Computational procedure has accordingly been modified to facilitate prompt summarization of results after the field work in a given survey unit has been completed. Sorting and tabulating machines are being used for this summarization work; data coding and card punching work proceeds simultaneously with the receipt of field tally sheets.

Two very important accomplishments of the survey staff during 1933 were the revision of plans used in the bottomland hardwood and shortleaf pine units in order to make them apply to other parts of the South, and the preparation of the working plan for the naval stores unit. This latter involved the complex problems of inventory of naval stores products and wood products, and the growth of trees before, during and after turpentining.

Field data were gathered for the construction of pine and hardwood volume tables for the northern Florida unit. A tentative plan for determining the growth of naval stores timber has been prepared. Plans are also under way for an economic study of the naval stores industry.

The accomplishments of the Forest Survey to December 31, 1933, are summarized in the following table:

Unit		Unit	Status of field work			Status of office analysis Dec. 31, 1933
Location	Type	Total area	Date begun	Date completed	Area completed by Dec. 31, 1933	
		Thousand acres			Thousand acres	
Miss.	Bot. Hdwd.	4,420	Jan.1932	Aug.1932	4,420	Completed
N. Miss.	Pine-Hdwd.	8,188	Feb.1932	Apr.1933	8,188	70% Completed
Cent.Miss.	Pine	12,000	May 1933	-	1,280	-
N. La.	Bot. Hdwd.	4,000	Nov.1933	-	1,600	5% Completed
SE. Ga.	Naval Stores	11,650	Nov.1933	-	1,300	-
NE. Fla.	Naval Stores	9,500	Nov.1933	-	1,000	-
Total		49,758	-	-	17,780	-

Forest Pathology (Pine)

The investigation of the brown-spot needle disease (Septoria acicola) of longleaf pine seedlings continues as the main project. This study is divided into two separate investigations: (1) the effect of the disease on seedling development; and (2) the effect of fire as a method of disease control.

To gauge the effect of the defoliations on seedling growth, control of the disease is essential and has been accomplished by spraying at frequent intervals. One set of experiments is being conducted in a densely stocked area of natural longleaf reproduction near Bogalusa, Louisiana. The cumulative dwarfing effect of the disease over a period of years is indicated by consistently better growth of sprayed seedlings compared with that of unsprayed and infected plants in alternate plots. Another spraying test involves nursery grown seedlings in plantations and is designed to eliminate the variations encountered when working with natural reproduction. In this latter test, the experimental work has given striking results. By the end of the fifth season in the field, the effect of eliminating the disease by spraying had resulted in an increase in average diameter of the treated seedlings 2.8 times that of unsprayed seedlings in adjacent rows. At the same time, the average height of the former seedlings was 27 inches, as compared with 2.6 inches for the unsprayed plants.

Some fundamental phases of the brown spot disease problem have also been investigated. It is indicated that dissemination of the disease in nature occurs through the agency of wind and by the spattering of rain. Where seedling density is high the greater amount of infection occurs through the latter method of spore dissemination. Rainy weather seems to favor dissemination of the fungus. However, two or more days of rainy weather are needed for abundant spore production, as an ordinary shower does not last long enough to open up the fruiting bodies of the fungus. One of the factors believed responsible for the resistance of the foliage of sapling trees to disease is the individual capacity of the tree to produce sufficient resin in the leaves to limit the internal progress of the fungus.

Extensive surveys have been made in the longleaf region from South Carolina to Texas to determine the effect of winter fires as a method of disease control. It has been found that a single fire will reduce the disease in all areas for the first season and often to a lesser extent the second season. During the third season following a single fire the disease usually reverts to the original status. However, in occasional cases the influence of a single fire can still be observed for the third season.

Direct evidence of the effect of fire on seedling growth rate was obtained by measuring the heights of 250 5-year-old longleaf seedlings growing in a plantation that had been burned by an accidental fire in March 2 years previously. For comparison, the same number of seedlings from the same nursery and planted at the same time were measured on an adjacent unburned area. The average height of the seedlings on the burned area was 8.4 inches and on the unburned, 3.9 inches. The two lots of measured seedlings were believed to be comparable in all respects save for the single fire. The greater height of seedlings on the burned area is considered to be due in a large measure to a reduction in the brown-spot needle blight following the single fire.

Products Pathology

Experimental work in products pathology has continued to deal largely with the testing of chemical dips and sprays for the control of sap stain, mold, and early decay in lumber and logs. Lignasan (ethyl mercury chloride) and borax have continued to give excellent results on dipped hardwood lumber. On pine stock the problem has been more difficult, with Lignasan failing frequently, in contrast to more favorable results in former years. This is attributed to the tendency of this material to volatilize slowly and leave the lumber unprotected in cases where seasoning is prolonged. The past winter was unusually severe in this respect at points where tests were run, extensive periods of cloudy and rainy days being frequent.

Most important among the results of this season's tests have been the highly satisfactory showing of two new treatments: sodium tetrachlorophenolate and sodium 2-chloroorthophenylphenolate. The former ranked equally with Lignasan in controlling sap stain on hardwoods and was markedly effective, although less outstanding, on pine lumber. Sodium 2-chloroorthophenylphenolate was not effective on hardwood material, but gave excellent control on pine. The results were so consistently good that the manufacturers of these compounds have placed them on the marked: (1) in mixture, under the trade name "Dowicide-P," for treating pine stock and where both pine and hardwood lumber are to be passed through the same solution; and (2) the sodium tetrachlorophenolate alone, "Dowicide-H," for treating hardwood material. The results of special tests indicate that these compounds do not volatilize appreciably and are comparatively resistant to rain-washing.

The testing of sprays for the prevention of log deterioration resulted in further confirming the practicability of this procedure where hardwood logs are banked for long periods before carrying them to the sawmill. The previously established treatments were again found to be superior to new ones, with the possible exception of chlorinated cresol and pentachlorodiphenyloxide, both of which will be given further trials. None of the chemicals used proved effective in the control of insect attacks, hence the use of spray treatments during the summer months, when this type of damage is serious, may be unsuccessful. The ideal log treatment is one possessing insect repellent, as well as fungicidal properties.

Special pretreatment, dipping, and spray tests on pole and piling material, designed to permit greater length of air seasoning preliminary to pressure treatment without the danger of encountering a prohibitive amount of decay gave promising results during the early part of the year. However, rapid deterioration took place shortly after spraying was discontinued. At the present time it seems that successful pre-treatment of poles and piling is probably economically prohibitive for two reasons: (1) it is almost impossible to treat the material soon enough after cutting to prevent interior infection; and (2) the cost of spraying frequently enough to keep up with the opening of checks would be excessive. Tests on post material, 6 inches or less in diameter, were more successful and may be repeated.

A prominent feature of the present sap stain control investigations deals with problems of the small mill. This phase of the work was started in July, 1933. Although the essential features of control as practiced by the larger mills apply, there are frequently certain differences pertaining to small mill procedure, which must be specifically considered in the light of their effect on the dipping treatment. Those features of the small mill which are receiving most attention are: (1) bulk piling of green lumber; (2) subjection of the lumber to an unusual amount of rain wetting between the saw and the seasoning yard and in the seasoning pile; and (3) delay of dipping after sawing.

Further field work will include limited trials of new chemicals, an attempt to establish the methods of dissemination of the sap stain organisms, an increased amount of attention given to the effectiveness of certain chemicals in controlling decay and insect damage, and experimental work directed at the adoption of present lumber dipping facilities to small-mill operations.

PLANS FOR 1934

The chief activity of the Station during 1934 will center around the development of the new experimental forests in Mississippi, Florida, Arkansas, and Louisiana. According to the funds available, these areas will be put in the best possible shape for use as research field laboratories. The Forest Survey will be pushed to completion as rapidly as possible, concentrating first on the primary naval stores belt and on the bottomland hardwood region of the Mississippi River Delta. All regular research projects will be carried forward and present projects expanded as rapidly as available funds permit.

R-SS
Investigative Program December 31, 1933.

ARTICLES PUBLISHED OR SUBMITTED FOR PUBLICATION

January 1, 1933 - December 31, 1933.

Bond, W. E. - "The Industrial Opportunity for Private Forestry in the South." Southern Lumberman 147(1865):61-62. December 15, 1933.

Bond, W. E., Reynolds, R. R., and Spillers, A. R. - "Financial Aspects of Growing Southern Pine in Union Parish, Louisiana." Submitted to Washington.

Chapman, A. D. - "Effect of Steam Sterilization on Susceptibility of wood to Blue-Staining and Wood-Destroying Fungi." Journal of Agricultural Research 47(6):369-374. Illus. September 15, 1933.

Chapman, A. D. and Scheffer, T. C. - "New Chemical Treatments for the Control of Sap Stain and Mold in Southern Pine and Hardwood Lumber." Southern Lumberman 146(1851):25-30. May 15, 1933.

Demmon, E. L. "Forest Fires in the South." Submitted to Washington.

"President Roosevelt's Unemployment Relief Reforestation Program in the South." Southern Lumberman 146(1849):20. April 15, 1933.

"The Forestry Outlook in the South." Southern Lumberman 147(1865):57-60. December 15, 1933.

Demmon, E. L., and Eldredge, I. F. (Co-authors with Roberts, P. R., Baker, W. M., and Show, S. B.) - "The Programs Summarized as to Costs, Financing, and Needed Legislation." In "A National Plan for American Forestry." Senate Document No. 12, 73d Congress, pp. 1587-1638. 1933.

Eldredge, I. F. - "Forest Extension - An Appraisal and a Program." in "A National Plan for American Forestry." Senate Document No. 12, 73d Congress, pp. 1575-1586. 1933.

Foster, E. A. - "Fire Damage Portrayed in Stone Stump Part of Confederate Soldier Monument." Service Bulletin 17(16):8. July 31, 1933.

Gemmer, E. W. - "Choctawhatchee Planting Tool." Journal of Forestry 31(5):598-599. May, 1933.

Harper, V. L. - "The Olustee Experimental Forest." Weekly Naval Stores Review 43(25):4. September 16, 1933.

Harper, V. L. and Wyman, L. - "Variation in Naval Stores Yields Associated with Weather and Elapsed Time Since Chipping." Submitted to Washington.

Heyward, F. D. - "Monthly Trend of Needle Fall in Longleaf Pine in Northern Florida for Period August 1932 to August 1933." Weekly Naval Stores Review 43(34):12. November 18, 1933.

"The Root System of Longleaf Pine in the Deep Sands of Western Florida." Ecology 14(2): 136-148. April, 1933.

Heyward, F. D. and Barnette, R. M. - "The Effect of Frequent Fires on the Chemical Composition of Forest Soils in the Longleaf Pine Region." Submitted to Washington.

Lentz, G. H. - "Carrying on the Forest Survey in the South." Empire Forester, New York State College of Forestry Annual, 1933, pp. 27-29.

"Top Diameter Utilization Limits for Delta Hardwoods." Journal of Forestry 31(5):547-550. May, 1933.

Lindgren, R. M., Scheffer, T. C., and Chapman, A. D. - "Tests of Chemical Treatments for Control of Sap-Stain and Mold in Southern Lumber." Industrial and Engineering Chemistry 25(1):72-75. January, 1933.

Meginnis, H. G. - "Tree Planting to Reclaim Gullied Lands in the South." Journal of Forestry 31(6):649-656. October, 1933.

"Using Soil-Binding Plants to Reclaim Gullies in the South." U.S.D.A. Farmers' Bulletin 1697. 1933.

Meginnis, H. G., (Co-author with Munns, E. N., Chapline, W. R., Forbes, R. D., and Kellogg, L. F.) - "Watershed and Related Forest Influences." In "A National Plan for American Forestry." Senate Document No. 12, 73d Congress, pp.299-462. 1933.

Pessin, L. J. - "Annual Ring Formation in *Pinus palustris* Seedlings." Submitted to American Journal of Botany.

"Forest Associations in the Uplands of the Lower Gulf Coastal Plain (Longleaf Pine Belt)." Ecology 14(1):1-14. January, 1933.

Reynolds, R. R. - "Natural Seeding of Shortleaf and Loblolly Pine Over Long Distances." Service Bulletin 17(17): 3. August 14, 1933.

"Truck Logging of Pine in Mississippi and Louisiana." Southern Lumberman 9(103):23-26. September 15, 1933.

"Volume Tables to Fixed Top Diameters." Submitted to Journal of Forestry.

Siggers, P. V. - "Nursery Control of the Brown Spot Needle Blight of Pine Seedlings." Occasional Paper No. 29. Multigraphed for limited distribution, December, 1933.

"Observations of the Influence of Fire on the Brown-Spot Needle Blight of Longleaf Pine Seedlings." Submitted to Journal of Forestry.

Southern Forest Experiment - "Southern Forestry Notes" - Nos. 1-4, June, September, November, and December 1933. Multigraphed for limited distribution.

"Stand-Improvement Measures for Southern Forests." Emergency Conservation Work Forestry Publication No. 3. 1933.

Wackerman, A. E. - "Allocating Cutting Budgets by Means of a Forest Sky-Line Graph." Submitted to Journal of Forestry.

"Selective Cutting for Sustained Yield: Good Business." Southern Lumberman 147(1865):74. December 15, 1933.

Wackerman, A. E., and Spillers, A. R. - "Labor versus Machinery in the Lumber Industry." Southern Lumberman 146(1853):21-23. June 15, 1933.

Wahlenberg, W. G., Greene, S. W., and Reed, H. R. - "Cattle Raising and Timber Growing in the South." Submitted to Washington.

Wakeley, P. C. - "Artificial Reforestation in the Southern Pine Region." Submitted to Washington.

Winters, R. K. - "The Use of Fixed Top Diameters in Volume Table Construction for Bottomland Hardwood Species." Journal of Forestry 31(4):427-429. April, 1933,

"Weight of Fruit of Quercus nuttallii." Journal of Forestry 31(3)340-341. March, 1933.

Wyman, L. - "Conservative Chipping Proves to be Good Hurricane Insurance." Weekly Naval Stores Review 43(36):8. December 2, 1933.

"Management of Farm Woodlands for Naval Stores Production." Journal of Forestry 31(7):849-852. November, 1933.

"Turpentining Tests in Slash and Longleaf Pine." Proposed as Government Bulletin.

Wyman, L., and Coulter, C. H. - "Florida Naval Stores." Florida Forest Service Bulletin No. 9 (Revised). 1933.

Radio Addresses Over Station WWL, Loyola University, New Orleans, Louisiana.

Pessin, L. J. - "How Forest Trees Reproduce." January 6, 1933.

Reynolds, R. R. - "Some Aspects of Forestry in Louisiana." March 11, 1933.

Wackerman, A. E. - "Technocracy's Question and the Lumber Industry." January 13, 1933.

3.21

AGR[illegible] DEPARTMENT
CLEMSON COLLEGE LIBRARY

R-SS
Investigative Program

March 1, 1935

FOURTEENTH ANNUAL REPORT

of the

SOUTHERN FOREST EXPERIMENT STATION

New Orleans, La.

January 1, 1934 - December 31, 1934

TABLE OF CONTENTS

	Page Number
Introduction	1
Social Aspects of Forest Research	1
Station's Progress during 1934	2
Personnel	4
Library	5
Advisory Council	6
Experimental Forests	7
Crossett Experimental Forest	7
Harrison Experimental Forest	8
Olustee Experimental Forest	8
Palustris Experimental Forest	8
Natural Areas	8
Use of Emergency Funds	9
Emergency Conservation Work (ECW)	9
Civil Works Administration(CWA)	11
Federal Emergency Relief Administration (FERA)	12
National Industrial Recovery Act (NIRA)	12
Curent Investigations:	
Fire	13
Controlled Burning	14
Management:	
Natural Reproduction	14
Methods of Cutting	16
Thinning	16
Stand Betterment	17
Forestation	18
Measurements:	
Southern Pines	20
Hardwoods	20
Naval Stores	21
Woods Practices	21
1. Tree Selection	21
2. Hanging of Cups	22
3. Methods of Working Trees	22
4. Back Faces	23
5. Raising Tins	23
6. Scraping	23
7. Dipping	23
8. Supervision	23
Naval Stores and Fire	24

TABLE OF CONTENTS - Contd.

Page Number

Erosion-Streamflow 25
Erosion Control Studies 25
Run-Off and Erosion Studies 27
Financial Aspects of Private Forestry 28
New Public Domain 29
Forest Survey 31
Progress Report 32

Forest Pathology:

Pine 34
Slash Disposal Methods 35
Nursery Diseases on Locust 36
Forest Products Pathology 36

Forest Entomology:

Forest Tree Insects 37
Nursery Insects 38
Forest Products Insects 39
Plans for 1935 39
Articles Published or Submitted for Publication 40
Radio Addresses 43

STAFF
SOUTHERN FOREST EXPERIMENT STATION
January 1, 1934 - December 31, 1934.

E. L. Demmon	Director
I. F. Eldredge	Principal Forest Economist
W. E. Bond	Forest Economist
A. E. Wackerman (resigned May 14, 1934)	Forester
W. G. Wahlenberg	Forester
R. K. Winters	Forester
V. L. Harper	Silviculturist
Mark M. Lehrbas	Silviculturist
H. G. Meginnis	Silviculturist
T. E. Snyder (from July 1, 1934) Bureau of Entomology and Plant Quarantine	Senior Entomologist
P. C. Wakeley	Associate Silvuculturist
Lenthall Wyman (resigned September 12, 1934)	Associate Silviculturist
E. W. Gemmer	Associate Silviculturist
L. J. Pessin	Associate Forest Ecologist
P. V. Siggers (Forest Pathology, B.P.I.)	Associate Pathologist
R. B. Craig	Associate Forest Economist
J. W. Cruikshank	Technical Foreman
V. B. Davis	Technical Foreman
E. B. Faulks	Technical Foreman
J. A. Putnam	Technical Foreman
Henry Bull	Assistant Silviculturist
Roy A. Chapman	Assistant Silviculturist
F. D. Heyward	Assistant Silviculturist
C. F. Olson	Assistant Silviculturist
P. R. Wheeler	Assistant Forest Economist
R. E. Worthington (appointed May 1, 1934)	Assistant Forest Economist
R. R. Reynolds	Assistant Conservationist
C. A. Bickford	Junior Forester
Halsey M. Hicks (appointed March 5, 1934)	Junior Forester
Morris A. Huberman (appointed March 8, 1934)	Junior Forester
T. A. Liefeld	Junior Forester
T. E. Maki	Junior Forester
George E. Morrill (appointed March 10, 1934)	Junior Forester
J. G. Osborne	Junior Forester
Harry F. Smith	Junior Forester
Wm. S. Stover (appointed March 5, 1934)	Junior Forester
T. E. Pease	Senior Forest Ranger
Ira Hatfield (from September 1, 1934) Forest Pathology, B.P.I.	Field Assistant
T. C. Scheffer (Forest Pathology, B.P.I.) Appointment terminated September 30, 1934	Agent
John A. Lubbe	Jr. Administrative Assistant
Vera S. Lind	Senior Clerk
Effie H. Hunt (resigned May 15, 1934)	Clerk-Stenographer
Marie M. Flad	Clerk-Stenographer
Clark H. Streetman (appointed February 16, 1934)	Clerk
Mary R. Craig	Asst. Clerk (Statistical)

Camelia M. Larsen ....Asst. Clerk-Stenographer
Lucille P. Olsen ....Junior Clerk (Statistical)
Elizabeth Bergland ....Junior Clerk-Stenographer
Mary S. Gloger ....Junior Clerk-Stenographer
Ruth Marshall ....Junior Clerk-Stenographer
May M. Patchett ....Junior Clerk-Stenographer
Leo W. Cooper (resigned November 30, 1934)..Junior Messenger

TEMPORARY TECHNICAL STAFF

Joseph Yanoso (from June 1, 1934) ....Technician
T. S. Coile (resigned September 24, 1934) ..Technician
C. C. Delavan (from October 1, 1934) ....Technician
T. C. Evans ....Technician
Norman E. Ha[illegible]s (appointed September 4,1934)Technician
John C. Sammi (from June [illegible], 1934 to September
3, 1934) ....Technician
Ralph R. Wilson (appointed August 27, 1934).Technician
Norman P. Worthington(from August 1, 1934) .Technician
Allan G. Watkins (from May 5, 1934) ....Assistant Technician
R. H. Church (from April 30, 1934 to July 6,
1934, inclusive) ....Chief Surveyor-Draftsman
Alfred M. Ewing (from November 21, 1934) ...Laboratory Assistant
A. L. Shepard (from January 2, 1934) ....Foreman
Samuel Eff (from June 16, 1934 to August 15,
1934, inclusive) ....Sub-Foreman
Ike Rawls (from December 1, 1934) ....Sub-Foreman
Howard Lamb (from June 16, 1934) Forest
Pathology, Bureau of Plant
industry. ....Junior Pathologist

Technicians Assigned to Survey

R. S.Andrews
C. H. Caskey
W. P. David
John Earley
R. Y. Edmondson
A. D. Ernest
Wm. E. Houser
M. S. Kohler
F. J. Lemieux
E. J. Mason
W. F. Mershon
R. L. Mosely
J. R. Nevers
D. G. O'Kelley
L. E. Price
J. W. Reno
. H. Thompson
J. M.Tinker
W. J. Walsh
N. M.White
R. E. Womack
W. E. Wright
Louis M. Zeigler

C. H. Coulter (appointment terminated June 30, 1934) Assistant Conservationist.

Assistant Technicians Assigned to Survey

R. D.Andrews
Carl A. Ba[illegible]k
H. G. Backus
L. E. Baker
Frank P. Beasley
James H. Blackerby
R. [illegible].Bryce
C. H. Carr
P. [illegible]. Chestnolvick
W. J. Clark
W. P.Coggins
J. K. Cross
C. [illegible]. Deberle
C. E.Edmondson
F. Flaherty,Jr.
Robert Fokes
Burl Forney
L. W. Forgey

G. P. Forman
B. M. Franklin
J. W. Girard, Jr.
W. G. Goodner
J. P. Hale, Jr.
A. M. Harrison
T. P. Hursey
W. E. Jenkins
J. P. Johnson
M. M. Johnson
Nathan Johnson
L. F. Landry
G. B. Lane
T. J. Lang, Jr.

A. G. Loessner, Jr.
J. K. Malpas
R. E. Matthews
C. G. McCoy
J. P. McKee
M. J. Montgomery
J. C. Moore
W. G. Patterson
A. A. Pierce, Jr.
J. C. Rawls
M. G. Rawls
A. L. Redmond
W. C. Ring
F. T. Ritchie

C. O. Scott
H. O. Seymour
C. T. Snowden
M. S. Spencer
J. F. Spiers
A. G. Steedley
E. J. Sylvester
L. S. Tate
Theo. Tate, Jr.
A. D. Toler
A. D. Vickers
D. M. Wallace
R. E. Whitney
W. A. Wimbish
W. F. Yow

Office Force - Temporary

Florence V. Alexander	Senior Stenographer
Julia O. Dumestre	Senior Stenographer
Madeleine Archinaud	Senior Clerk-Stenographer
E. A. Schaefer	Senior Clerk
Elsa M. Rayl	Clerk
Sarine Lake	Assistant Clerk
Herbert Berrigan	Jr. Tabulating Mch. Operator
Hannah M. Carpenter	Jr. Tabulating Mch. Operator
Charles H. Langhoff, Jr.	Jr. Tabulating Mch. Operator
Martha E. Nelson	Jr. Tabulating Mch. Operator
Elmire A. Even	Jr. Calculating Mch.Operator
Evelyn A. Thompson	Jr. Calculating Mch.Operator
Henry A. Wilde	Jr. Calculating Mch.Operator
Elizabeth Cotten	Jr. Card-Punch Operator
Gladys Hodges	Stenographer
Annette Andrews (Resigned October 22, 1934)	Junior Clerk
Pierre A. Archinaud	Junior Clerk
Mildred Beach	Junior Clerk
Honora Cassens	Junior Clerk
Leo W. Cooper	Junior Clerk
Mary Duncan (Resigned August 25, 1934)	Junior Clerk
Ogarita M. Duncan	Junior Clerk
L. P. Gaudin	Junior Clerk
Ruby Green	Junior Clerk
Pearl S. Holland	Junior Clerk
Bertha Hyman	Junior Clerk
Marie Preau	Junior Clerk
Kathyrine Rogan	Junior Clerk
C. T. Roper	Junior Clerk
Helen Schweitzer	Junior Clerk
Kate E. Thomson	Junior Clerk
Lee F. Tobin	Junior Clerk
Una Zaffers	Junior Clerk
Henry Foltmer	Messenger

SOUTHERN FOREST RESEARCH ADVISORY COUNCIL

L. J. Arnold, Manager, Crossett Lumber Company, Crossett, Arkansas.

L. Warrington Baldwin, President, Missouri Pacific Railroad Company,
St. Louis, Missouri.

W. H. Barnwell, Georgia Power Company, Atlanta, Georgia.

Col. R. E. Benedict, Brunswick Peninsula Company, Brunswick, Georgia.

Col. P. S. Bunker, State Forester, Montgomery, Alabama.

Prof. H. H. Chapman, Yale University, New Haven, Connecticut.

L. O. Crosby, President, Goodyear Yellow Pine Lumber Company,
Picayune, Mississippi.

Col. D. T. Cushing, General Manager, Great Southern Lumber Company,
Bogalusa, Louisiana.

Mark Fenton, General Industrial Agent, Illinois Central System,
Chicago, Illinois.

Hon. H. E. Hardtner, President, Urania Lumber Company, Urania, Louisiana.

Dr. Chas. H. Herty, Research Chemist, Savannah, Georgia.

F. M. Joy, Tennessee Coal, Iron, and Railroad Company, Birmingham, Alabama.

A. L. Kuehn, President, American Creosoting Company, Louisville, Kentucky.

Prof. G. D. Marckworth, Georgia Agricultural College, Athens, Georgia.

Dr. Wilmon Newell, Director, Agricultural Experiment Station, Gainesville,
Florida.

F. W. Scott, General Manager, Union Sawmill Company, Huttig, Arkansas.

E. Marvin Sessoms, Vice-President, Consolidated Naval Stores Company,
Jacksonville, Florida.

C. C. Sheppard, General Manager, Louisiana Central Lumber Company,
Clarks, Louisiana.

E. O. Siecke, Director, Texas Forest Service, College Station, Texas.

Carl F. Speh, Secretary-Manager, Pine Institute of America, Inc.,
Jacksonville, Florida.

T. G. Woolford, President, Retail Credit Company, Atlanta, Georgia.

R-SS
Investigative Program

March 1, 1935.

FOURTEENTH ANNUAL REPORT
# of the
SOUTHERN FOREST EXPERIMENT STATION

January 1, 1934 - December 1, 1934.

General

Introduction

This report summarizes the progress of forest investigations under way at the Southern Forest Experiment Station during 1934 and outlines plans for 1935. It is the fourteenth of a series of reports issued annually since the Station was established in July 1921. This regional station, one of eleven such stations in the United States, serves the eight states extending from Georgia and Florida westward to eastern Texas and Oklahoma. One phase of the Station's work, the Forest Survey of the South, has extended its activities into the pine lands of North and South Carolina, the bottomland hardwood area of the Mississippi Delta in Missouri, Tennessee, and Kentucky, and to parts of the Tennessee Valley.

The Social Aspects of Forest Research

During the last year, an increasing stress has been placed on the social aspects of forestry on the relation of the use of forest land to the social and economic welfare and rehabilitation of all people. This has always been the fundamental concept of the Forest Service - "the greatest good for the largest number of people in the long run" - but under the program of social reconstruction launched during 1933-34 by President Roosevelt, a change in the stress placed on the immediacy of this benefit has taken place. The most obvious evidence of this change, with the exception of the wage and hours of labor provisions of the N. I. R. A. Codes, is, perhaps the establishment of the National Resources Board in April, 1934. This pooling of the resources of all governmental agencies concerned with land and its uses has as its primary purpose the development, on a soundly practical basis, of a National policy for the most socially desirable and economically efficient use of the land of the whole country, to provide for the realization as soon as possible of the Forest Service ideal previously stated.

In this change of stress, and in the collection of the fundamental data on which such a change must be based, forest research has had its part. Keeping in mind always the "greatest good of the largest number of people," the Southern Forest Experiment Station has aided in the collection and interpretation of data for the report of the Forest Service to the National Resources Board; the Lumber Code Authority, through its subsidiary regional agencies, has called frequently on the Station for data on management, costs and returns, taxation, and protection of Forest lands. A great demand has arisen for data taken by the Forest Survey on forest resources. The several states and numerous individuals have made similar requests. Throughout the region, both the number and the variety of requests for information addressed to the Southern Station have increased to a point far above that reached in any previous year.

In the opportunity for service to the social and economic welfare and rehabilitation of all people, the forests of the South rank high. Here are found 191,000,000 acres of commercial forest land, 39 percent of all that in the nation. Within the South's borders is found the second largest volume of sawtimber in all regions, 200 billion board feet. These forests are growing in volume at the rate of 4.8 billion cubic feet a year, 54 percent of the total forest growth of the nation. Here also are found a climate and topography generally conducive to year-long work in the woods, abundant and skilled labor, adequate transportation facilities, the source of two-thirds of the world's annual production of naval stores, an almost untouched source of pulpwood of vast possibilities - indeed, almost all the resources and potentialities of a forest empire capable of providing year-long profitable labor for a large portion of her population of all classes and color.

One other aspect of the relation of the South's forest to the social welfare of her people is the fact that 73 percent of her gross area is actual or potential forest land; 64 percent is commercial forest land. It may not be too much to say that in her forest wealth the South holds, to a large degree, the key to that region-wide social and economic rehabilitation which is so earnestly desired. To aid with all its resources in the consummation of this desire, the Southern Forest Experiment Station plans, during 1935, to undertake numerous studies of a social-economic character, in order to arrive at the basic data on which state or regional land-use plans can be established.

Station's Progress During 1934

As in 1933, much of the progress made by the Southern Station during 1934 was made possible only through the availability of emergency funds. This is particularly true of the development of experimental forests and of the progress made at the New Orleans Office in bringing the library, computing, and general office work up to date.

The main achievements during 1934 may be summarized as follow

1. The completion by the Forest Survey of the forest inventory on 67 million acres, bringing the total area in the South covered to January 1, 1935, by line-plot survey to 85,000,000 acres.

2. Planting of 38,000 trees on experimental plots in north Louisiana in a study of effect on seedling growth and development of source of seed, method of pre-treatment and storage of seed, method of planting, fertilization, and spacing. This is the beginning of a 10-year forestation research program involving the planting out of about 320,000 trees.

3. Development of a pre-treatment of black locust seed with sulphuric acid as an aid in hastening germination and increasing germination percent.

4. Determination that dipped green lumber can be bulk-piled for as long as four weeks without danger of sap-staining, if proper cover is provided, but that where insect damage is present in the log a delay of one day in dipping might allow as much as 50 percent of the lumber surface to stain.

5. Establishment and partial development of three experimental forests: The Crossett, in the shortleaf-loblolly pine-hardwood type of southeastern Arkansas; the Harrison, in the longleaf pine type on the Biloxi Unit of the DeSoto National Forest in southern Mississippi; and the Palustris, in the longleaf pine type on the Catahoula and Evangeline Units of the Kisatchie National Forest in central Louisiana. The Olustee Experimental Forest in the longleaf-slash pine type on the Osceola National Forest in northeastern Florida was further developed and improved. This development work occupied a large part of the time of the regular staff.

6. Completion of first or final drafts of seven major manuscripts for publication, entitled;

   "Artificial Reforestation in the Southern Pine Region"

   "Effect of Cover on Surface Run-off and Erosion in the Loessial Uplands of Mississippi"

   "Methods of Increasing the Germination of Black Locust Seed"

   "Use of Land for Forests in the Lower Piedmont Region of Georgia"

   "Cattle Raising and Timber Growing in the South" (in cooperation with the Bureau of Animal Industry and Bureau of Plant Industry)

   "The Problem of Forest Land Tax Delinquency in Arkansas" (in cooperation with the Arkansas Agricultural Experiment Station)

   "Preliminary Report on the Forest Survey of the Bottomland Hardwood Unit in Mississippi"

7. Making available current Station findings through three media of multigraphed material: "Occasional Papers," "Forest Survey Releases," and "Southern Forestry Notes."

   Ten "Occasional Papers," four "Survey Releases" (exclusive of those issued as "Occasional Papers"), and four issues of "Southern Forestry Notes" have been released during the year.

8. Continued assistance to and cooperation with the Lumber Code and Naval Stores Marketing Agencies in formulation of conservation measures under Article X of the Lumber Code and comparable provisions of the Naval Stores Marketing Agreement and in supplying to these agencies basic data and information on forest protection, management, forestation, and taxation based on the Station's findings.

9. Assistance to the Regional Office of the Forest Service and to various federal agencies grouped under the Nationa Resources Board and the Land Policy Section of the Agricultural Adjustment Administration in obtaining and explaining certain data which they included in their report on landuse to the National Resources Board and to the President.

10. Inauguration of several studies of a social-economic nature aimed to provide, in connection with Survey resources data, for the whole people as well as for the forest industries a sound basis for efficient, profitable and permanent use of the forests of the South.

11. Assignment of a Forest Entomologist to the Station, effective July 15, 1934.

The stress on forestry activities continues, through the Civilian Conservation Corps, the Lumber Code and Naval Stores Agreement, the National Resources Board and the Land Policy Section of the AAA, and similar public and quasi-public agencies, as well as through increased interest and activity on the part of private timber-land owners, evidenced by the increase in number and variety of the requests for information on and assistance in solving their forest problems. All these agencies, public and private, are looking to research to help supply this information. This can be best supplied through expansion of the forest research program.

Personnel

During 1934 the Station lost two of its regular technical staff. Lenthall Wyman, Associate Silviculturist, who had been with the Station since its establishment in 1921, resigned in September to accept a position as professor of forestry at North Carolina State Agricultural College, Raleigh, N. C. A. E. Wackerman, Forester, resigned in May to accept a position as Forester for the Southern Pine Association, the Lumber Code Agency for the southern pine region. The Bureau of Plant

Industry terminated the appointment of T. C. Scheffer on September 10, in order that he could go to Johns Hopkins University for additional study.

Junior Forester R. A. Chapman continued on detail in the Washington Office of Forest Measurements until October, 1934. Other similar details were arranged for Junior Forester J. G. Osborne from September, 1933, to September, 1934, and for Junior Forester C. A. Bickford beginning September, 1934.

Emergency funds allotted to the Station have been used in part to employ additional technical men, particularly in the Forest Survey. The status of the Station personnel as of December 31, 1934, was as follows:

	Regular 1/ positions			Temporary positions							
				NIRA			ECW 2/			FERA 3/	
	Technical	Clerical	Total	Technical	Clerical	Total	Technical	Clerical	Total	Total	Grand Total
Station	31(3)	12(1)	43(4)	56	12	68	39	20	59	54	224
Bureau of Plant Industry	2		2								2
Bureau of Entomology & Plant Quarantine	1		1								1
Total	34(3)	12(1)	46(4)	56	12	68	39	20	59	54	227

1/ - Vacancies are included with the number of regular positions and are also shown separately in parentheses.
2/ - Exclusive of C. C. C. enrollees and foremen.
3/ - Total number of FERA employees, equivalent to about 41 full-time employees.

Library

The Station library was started shortly after the founding of the Station in 1921, with a small shipment of material from the Forest Service Library in Washington. A miscellany of bulletins, periodicals, forestry, books, and census reports made up the assignment. By 1926 the library consisted of about 200 books, 1,000 bulletins, periodicals, etc. An estimate made in January, 1934, showed 2,000 bound books, 700 volumes of periodicals, 15,000 bulletins, and 5,000 miscellaneous reports. The accretion for 1934 was 200 books, 500 copies of periodicals, 1,800 bulletins, and 1,000 reports and clippings.

A technical library does not consist, however, of a mere collection of readable material; it must be classified, indexed, and filed so that each article is readily available. Prior to 1934 the Society of American Foresters' Classification of Forestry was used for this purpose. It was not entirely satisfactory for Station purposes an in the fall of 1933 a radical revision of this classification was made. With the rapid expansion of the library during the past five years, the work of classifying and indexing had fallen far behind. The establishment of the CWA and ERA offered an opportunity to bring this work up to date. Two trained librarians and additional stenographic help were obtained. As a result the following work has been accomplished.

Author and subject index cards made for the following:

10,000 old publications, such as bulletins, circulars, etc transposed into new classifications.

1,800 new publications, such as bulletins, circulars, etc. classified and card indexed.

2,000 bound books and 700 volumes of periodicals listed and stenciled for distribution.

5,000 articles for report file classified and card indexed

200 abstracts and translations classified and card indexed

18,000 articles in 700 periodicals classified and card indexed.

2,000 books classified and card indexed.

2,000 cards typed for erosion bibliography.

To accomplish this work approximately 1,500 man-days were expended. Roughly this represents about 50 percent of the job. Another year with the present force will be required to put the library in a satisfactory working condition. After that it will require two librarians to maintain and assist in its proper utilization.

Advisory Council

The Southern Forest Research Advisory Council, comprised of 21 business, professional, and scientific men appointed by the Secretar of Agriculture and representing forest and allied industries in the Station's territory, acts in an advisory capacity to the Southern Stati The ninth meeting of the Council was held in Lake City, Florida, on December 7, 1934. Seven council members or their representatives and about 45 guests were present. Only one day was available for the meeti part of which was devoted to a field trip to the Olustee Experimental Forest, Osceola National Forest, Florida State Forest Nursery, and the Naval Stores Station of the Bureau of Chemistry and Soils. During the year council members were kept currently informed of the Station's progress. A list of members of the present Council appears in the front of this report.

Experimental Forests

The following experimental forests have been set aside and partially developed during 1934:

Name of Experimental Forest	Location: (National Forest) (State)	Gross area	Forest type	Predominant purpose
		Acres		
Crossett	Ashley County, Arkansas (not on National Forest).	1,680	Shortleaf-loblolly Hardwoods.	Sustained-yield management studies, economic and silvicultural; growth and yield studies.
Harrison	Bilxoi Unit DeSoto National Forest; and McNeill, Mississippi.	5,690	Longleaf pine.	Management studies, fire studies, growth and yield studies, and naval stores.
Olustee	Osceola National Forest, Florida	3,000	Longleaf-slash pine.	Naval stores studies, management studies, and fire studies.
Palustris	Kisatchie National Forest, Louisiana.	4,100	Longleaf pine	Forestation studies and fire studies.

Other secondary centers of work are located on the Homochitto Unit of the DeSoto National Forest and on the Holly Springs Unit of the same Forest in Mississippi, at Camp Pinchot, Florida (Choctawhatchee National Forest), and at Bogalusa and Urania, Louisiana. Additional centers of work will be established in the bottomland hardwood type in the Mississippi Delta, in the shortleaf pine-hardwood type on the Ouachita National Forest in Arkansas, and on the Sam Houston National Forest in Texas, and in the shortleaf-loblolly pine-hardwood type in the lower Piedmont region of Georgia.

The present status of development work on existing experimental forests is as follows:

Crossett Experimental Forest: During 1934, headquarters buildings were constructed, a road and fire-break system was nearly completed, a forest inventory taken, and growth study made on the Crossett Experimental Forest. The headquarters buildings include an office and laboratory building, garage, and pump house, equipped with an electric lighting plant and water system. The building site, a pasture and a cleared arboretum site have been fenced. Boundaries of the forest and compartments of 160 acres each have been surveyed. About 14 miles of roads have been cleared, of which 10 miles had been graded and one and one-half miles graveled. These roads also serve as fire-breaks and as boundaries of compartments. During the year the whole forest was inventoried, using a 20 percent estimate, and a detailed growth study was made.

Harrison Experimental Forest: With the selection of an experimental area on the Biloxi Purchase Unit in the fall of 1933, the Station was able to take advantage of the CWA to initiate development plans in January, 1934. Sixty acres of land around the headquarters site were stumped and cleared of all dead or down debris and 40 acres were fenced with hog-proof wire. Four miles of road were located, cleared, and partially graded. A topographic map of the 60 acres on the building site was made with a 2-foot contour interval, which has assisted in placing buildings, roadways, etc. During the summer of 1934, building construction was started. The following structures have been completed to date: Office-laboratory, greenhouse, residence, garage, equipment depot, light and water plant (including a 60 ft. well). When CCC help became available in December, 1934, the fire hazard created by the high grass around the buildings was removed.

Olustee Experimental Forest: Prior to 1934, there had been completed, chiefly through use of emergency funds, the following buildings on the Olustee Experimental Forest: Ranger's house and garage, combined laboratory and greenhouse, office building, combined equipment depot and workshop, 4-car garage, auto-service building, water-tower and pump house, and the necessary light, power, and water development. During 1934, a museum was built and the equipment depot and workshop remodeled, a laborer's log cabin and a log, lumber, and wood shed completed. The grounds were landscaped in part, though this work was not completed. In addition, the roads and major fire-lines were about 60 percent completed, and the boundary fence nearly completed. The labor for this work was very largely supplied by the Civil Works Administration.

Palustris Experimental Forest: This experimental forest was fenced, subdivided by fire-breaks, and a topographic map made, partly by CWA and partly by CCC labor. A cover map has also been made and the first planting, 38,000 trees, completed by CCC men. No buildings have been erected, except for a small office at the Stuart Nursery.

Natural Areas

Two natural areas were tentatively selected in Florida during 1934. One area is on the Osceola National Forest in the flatwoods type.

It contains a stand of virgin cypress and some large second-growth slash and longleaf pine. The other area is on the Ocala National Forest and contains an old stand of sand pine and about 100 acres of virgin longleaf. Selection of the second area depends upon acquiring certain properties, some of which are now under option.

Use of Emergency Funds

Federal emergency relief and recovery programs during 1934 have made possible considerable expansion of the Station's program and particularly have assisted in the rapid development of the experimental forests. Funds have also been used to offset curtailments in regular appropriations. The emergency programs come under four classifications: Emergency Conservation Work (ECW); Civil Works Administration (CWA); Federal Emergency Relief Administration (FERA); and National Industrial Recovery Act (NIRA).

Emergency Conservation Work (ECW)

Many of the Station's projects, including development of the experimental forests, have been aided materially by assignment of labor from the Civilian Conservation Corps Camps. As in 1933, the men worked directly out of the main camps or side-camps, but under the general supervision of members of the Station's staff. During 1934, a total of 7,724 man-days of CCC labor was supplied. Some of the labor has been employed almost continuously, while in other cases it was available for short periods of time as needed. The distribution of this labor by centers of work, type of camp, and by six months' periods was as follows:

			Man-days: 1934		
Centers of work	State	Type of Camp	January 1 to June 30	July 1 to December 31	Total
Olustee	Fla.	National Forest	738	2,440	3,178
Camp Pinchot	Fla.	National Forest	5	7	12
Harrison	Miss.	National Forest	-	378	378
Palustris	La.	National Forest	190	1,158	1,348
Crossett	Ark.	Private	587	1,312	1,899
Bogalusa	La.	Private	44	186	230
Urania	La.	Private	120	60	180
Holly Springs	Miss.	Erosion	16	356	372
Loxley	Ala.	Private	40	-	40
Homerville	Ga.	Private	46	41	87
Total			1,786	5,938	7,724

A brief summary of activities engaged in by CCC labor at these centers of work follows:

Camp Pinchot, Fla.: Sprayed with poison 40 acres of oak sprouts resulting from release cutting. Remeasured three experimental plots.

Olustee, Fla.: Construction and maintenance of range and boundary fences; landscaping and improvement of grounds and buildings at headquarters; construction and maintenance of roads, trails, cattle guards, and fire-lanes; construction of museum, laborer's cabin, sheds, and maintenance thereof; construction of forest nursery and planting of about 40,000 seedlings; surveying of boundary and compartment lines, and making of topographic and type map; research assistance on gum weighing, dipping, collection of soil samples, etc.; telephone line construction, etc.

Harrison, Miss.: Construction and maintenance of fences, cattle guards, and of trails at headquarters; landscaping and improvement of grounds on 5-acre headquarters site; maintenance of buildings (office, laboratory, ranger's house, greenhouse, sheds); clearing of arboretum site; assisting on research problems and in collection of soil samples.

Palustris, La. : Assisted CWA labor in fencing, sub-dividing, and making boundary surveys of tracts. Planted 38,000 trees in experimental plantings for grading, mixed species, and spacing studies. Development of research projects on Dry Prong Unit.

Crossett, Ark.: Development work on experimental forest in conjunction with CWA and FERA labor; surveying of boundary and compartment lines, road and bridge construction, and roadside improvement, cleaning and improvement of grounds at headquarters and arboretum sites; minor assistance in construction of buildings at headquarters (office and laboratory, garage, pump house, well, water-tower, etc.); fencing; fire suppression; stand betterment work; research assistance on inventory of experimental forest, growth and yield studies, and on timing studies of cost of logging.

Bogalusa, La.: Weeding, cleaning, and staking of composition-density experimental plots; remeasurement of trees in burned-over loblolly plantation; spraying and removing grass cover from certain experimental plots; excavation of roots of longleaf seedlings; assistance in taking of weather records, in trapping, and in collection of soil samples; repairing and maintenance of field equipment.

Urania, La.: Re-examination and remeasurement of experimental plots, including 10 thinning plots, two methods-of-cutting plots, and three growth-and-yield plots. Thinning of six experimental plots and piling and measurement of material removed. Experimental burning of seven fire-study plots.

Holly Springs, Miss.: Nursery work, including planting, weeding, cultivating, lifting nursery stock, etc. Also clearing out erosion settling tanks and weirs; construction of fire-lanes around experimental area; repairing fences; surveying and mapping of experimental area.

Loxley, Ala.: Research assistance in establishment of two series of thinning plots, totalling eight acres - thinning, mapping, tagging, and measuring trees.

Homerville, Ga.: Research assistance in a study of damage resulting from a 17,000-acre fire in longleaf-slash pine, near Cogdell, Ga.; surveying and staking of plots on a 504-acre experimental area for study of integrated utilization of forest products.

Civil Works Administration (CWA)

The Civil Works Administration unemployment relief program, inaugurated in December 1933, supplied the Station with skilled and unskilled labor during the four months it was in operation. The maximum allotment of personnel was 372, although this peak was not reached until mid-January. Both the allotment and hours of labor were reduced gradually during the period and finally terminated on April 28th, 1934.

A total of 19,836 man-days of labor was provided, distributed as follows:

State		Man-days
Ark.		2,127
Fla.		4,276
Ga.		61
La.:		
N.O. Office	- 1,680	
Field	- 7,398	
		9,078
Miss.		4,294
Total		19,836

This work merged generally into that carried on under the FERA, when the latter organization superseded the CWA in May.

Most of the field work consisted of development of experimental forests, labor on buildings, roads, fences, clearing of trails and fire-lanes, improvement of headquarters sites, and similar cultural work. The extent of this work is reported on in the section of this report dealing with experimental forests.

The work at the New Orleans Office was practically identical with that carried on under FERA and is reported on in the following sectio

CWA labor was also employed in connection with research projects in Georgia and Mississippi and to a limited extent in Florida.

Federal Emergency Relief Administration (FERA)

FERA assistance at the New Orleans headquarters was used on general stenographic and computing work, classifying and indexing of periodicals and other publications for the library, identification and mounting of herbarium specimens, and construction of relief models of experimental forests.

The work accomplished on the Crossett Experimental Forest consisted of construction of two miles of fence, two wells, nine small buildings, 18 small bridges, and 10 miles of truck trails. In addition, two camp grounds were developed, two acres planted for an arboretum, and 14 miles of boundary were surveyed.

Total man-days of labor utilized from May 1 to December 31, 1934, was 4,846, of which 3,035 man-days were at the New Orleans Office and 1,811 at Crossett.

National Industrial Recovery Act (NIRA)

Of the total NIRA allotment carried over from the preceding fiscal year (as of July 1, 1934), amounting to $108,031, a total of $78,183 was for the Forest Survey, $21,401 for construction of improvements, and the balance ($8,447) for research projects. As indicated in the section "Current Investigations - Forest Survey," the Survey Staff has been greatly augmented by NIRA allotments, in order to complete its huge task as soon as possible, in response to repeated demands for its data. NIRA funds were also used to augment the clerical and technical staffs at the New Orleans and Lake City Offices.

The construction of permanent improvements - buildings, water and light systems, and fences - on the Harrison and Crossett Experimental Forests, and construction of various small buildings or accessories at Camp Pinchot, Florida, and Bogalusa, Louisiana, were financed out of NIRA funds. In all, construction of seven structures costing from $500 to $2,500, four small buildings costing less than $500, and six miscellaneous constructions (chiefly wells, pumps, water supply systems, etc.) were financed with these funds.

Current Investigations

Fire

A detailed study was made of the effects of a 17,000-acre fire which occurred in April 1934, in southern Georgia on the property of the Timber Products Company. This fire occurred on land that had been under fire protection for the past 13 years and which supported excellent stands of young slash pine.

Outside of weather conditions and those created by the fire itself, there were three factors which influenced the amount of damage in the main path of the Cogdell fire, as shown in an analysis of data taken on 116 selected plots in young slash pine stands. In order of their importance they were (1) type of underbrush and ground cover; (2) stand density; and (3) diameter.

Height of vegetation particularly, and its abundance, seemed to determine its seriousness as a fuel hazard. Low grassy vegetation represented the least hazard and tall gallberry and other wood species the most severe fuel hazard as measured by tree mortality.

Slash pine stands with more than 1,000 trees per acre suffered almost total loss, while stands under 1,000 trees per acre suffered loss in proportion to density, vegetation and diameter being equal. The relationship of mortality of trees to stand density (diameter and other factors being constant) showed 50 percent mortality for stands of 200 trees per acre or less, 80 percent mortality for stands 1,000 trees per acre or over, and a gradual increase in mortality with density between those ranges. The average d.b.h. of these stands was 2.7 inches.

Stands of slash pine which averaged 1.5 inches or less in d.b.h. were practically wiped out, regardless of density, whereas stands averaging between 4 and 5 inches d.b.h. showed a marked decrease in mortality for open stands of 201 trees or less.

An experiment to determine the effect of varying intensities of burning on the development and survival of longleaf reproduction was begun. Five different fire treatments are being tested. Each treatment is replicated five times, making in all 25 plots of 1/10-acre each. Each of the 1/10-acre plots is divided into 9 milacre quadrats or a total of 225 quadrats. The treatments are:

1. Frequent light burning.
2. Frequent severe burning.
3. Periodic light burning.
4. Periodic severe burning.
5. Check plot (complete exclusion of fire).

Frequent man mean annual or biennial and periodic not oftener than every three years. Light burning refers to the use of fire at times when it will burn slowly; severe to times when a hot fire results. Longleaf seed was sown on the quadrats in the winter of 1933-34 and 1-year-old seedlings are now established, varying from a few to 80 seedlings per milacre.

Other phases of the fire project appear under sections headed "Natural Reproduction" and "Naval Stores and Fire."

Controlled burning:

A compilation was made of the available data on the labor cost of experimental controlled burning. For 10 controlled fires, covering 24 to 340 acres each, the labor cost (exclusive of transportation of crews, construction and maintenance of fire-breaks, and cost and depreciation of tools and equipment) ranged from 0.06 to 0.50 man-hours per acre. The 10 controlled-burning experiments from which these data were derived were located in longleaf and in loblolly-shortleaf-hardwoods types at Urania, Louisiana, and in longleaf and longleaf-slash types at McNeill, Mississippi, and Olustee, Florida. In general, the labor cost per acre decreased with increase in the area burned; and the area of the burn had more effect on the labor cost per acre than the forest type and the nature of the vegetation that provided fuel.

These data are by no means conclusive, but they do indicate that the labor cost of controlled burning is reasonably low and cannot, in itself, be considered a serious bar to the practice. More important than the cost, once it is shown not to be excessive, are the determination of the physical results of controlled burning and the conditions under which it is advisable. Controlled-burning experiments will be established on several of the Station's experimental forests during 1935.

Management

Natural Reproduction

The establishment of southern pine forests rests largely upon the various species' ability to reproduce themselves. With loblolly, shortleaf, and slash pines, this ability is very pronounced and the problem is chiefly one of obtaining quality rather than quantity. Longleaf pine is more refractory, reproduction often fails, and large areas of non-stocked or denuded land may result. Because longleaf is capable of occupying soils not suited to the other species and is relatively fire-resistant, it is important to southern forestry. Investigations have shown that the problem of obtaining natural reproduction of longleaf is a very complex one, calling for long-time and detailed studies into many phases of the life history of the pine. Studies have been initiated and are being conducted at Lake City and Camp Pinchot, Florida; McNeill, Mississippi; Urania and Bogalusa, Louisiana; for the purpose of integrating the factors involved. The principal factors brought to light are: The possible use and abuse of fire in the woods during the regeneration period; seedling losses due to brown-spot needle disease; seed losses due to insects, birds, and rodents; and the role of competition upon the establishment and development of the seedling crop into trees.

During the past year the establishment of three additional experimental forests has greatly increased the possibilities for study of these and other factors involved in the regeneration problem. Two areas, one in southern Mississippi and another near Alexandria, Louisiana, are situated in the longleaf pine belt, where the problem is most acute. The experimental area near Alexandria is excellently situated and extensive projects requiring large areas of uniform forest land are available. The third area, the Crossett Experimental Forest, in southeastern Arkansas, is located in the optimum range of the loblolly pine belt, but also contains some shortleaf and considerable hardwoods, all of which can be profitably studied.

Laboratory facilities are being provided on the Harrison experimental Forest to facilitate intensive, fundamental research into the life history of both longleaf and slash pines and to complement the field studies at all the experimental forests.

Results of work carried on at these new points, plus that from the older established centers of work, should soon provide sufficient knowledge of the reproduction problems to place these methods upon the same plane of certainty that now exists in the case of artificial forestation.

Intensive studies of various factors affecting the early growth of longleaf pine seedlings are under way at Bogalusa, Louisiana. Results after two growing seasons indicate the effect of root competition on the rate of growth of the seedlings. Densities of stocking of from 1 to 25 thousand seedlings per acre allow normal, healthy, and vigorous growth. Densities of 25 to 100 thousand seedlings per acre markedly retard growth. Competition from grass is also evident. Seedlings on areas from which the grass had been removed immediately responded, showing consistently greater growth than those on areas on which the grass cover had not been disturbed.

A heavy growth of vegetation and dead, matted litter from grass is a serious deterrent of seeding-in of areas protected from fire. Slash pine seeds (because production is heavy and some nearly every year) manage to get to the mineral soil fairly well; but longleaf seeds (a good crop coming only once in several years) tend to hang up in the litter, where they are eaten by birds, rodents, and insects, or germinate before reaching the soil. In an attempt to improve the seed-bed conditions for natural reproduction the following treatments were used on small experimental plots located on the Olustee Experimental Forest: (1) Mineral soil exposed and loosened; (2) cultivated (grass slightly chopped away and soil disturbed); (3) fresh burn; (4) one-year unburned; and (5) three-year unburned.

Examination after the first year following broadcasting of the same weight of seed for each plot showed that longleaf establishment was most successful on the fresh burn and poorest on the three-year unburned area. Slash pine showed the best establishment on the "cultivated" area. Results are given in the following table:

Seedling count and average height in October 1934
(nearly 1 year after seeding)

Seed-bed condition	Longleaf: Number as compared with mineral soil	Longleaf: Total length of needles	Slash: Number in percent of mineral soil	Slash: Height
	Percent	Inches	Percent	Inches
Mineral soil	100	7.5	100	5.9
Cultivated	54	8.3	156	6.3
Freshly burned	104	7.4	99	5.9
1-yr. unburned	68	8.7	36	6.6
3-yr. unburned	24	8.3	41	8.0

Methods of Cutting

No new sample plots were established during the year, but seven existing methods-of-cutting plots were remeasured and one was cut again. Work was concentrated on completing (with FERA aid) the stand table computations for the two large plots established in 1933 and preparing the establishment reports for these plots and for the associated studies on the same area.

The profit from improving the irregular stand of shortleaf-loblolly-hardwoods in northern Louisiana, which had been cut over about 30 years previous to the experiment, amounted to $6.90 per acre, based on costs and prices current in the spring of 1933, and to $2.91 per acre, based on costs and prices current in the summer of 1934. These figures represent the stumpage realization value, or the net profit to an operator who is also the owner of the stand. On an acre basis, approximately 3 cords of pine pulpwood and 800 board feet (Doyle rule) of pine and hardwood sawlogs were removed from the poorest trees, and 15 worthless hardwoods (10) inches and over in diameter) were girdled.

New methods-of-cutting studies will be established on several of the Station's experimental forests in 1935.

Thinning

No new thinning plots were established, but 13 of the existing thinning plots were remeasured and seven of these were thinned again. The work on this project during 1934 was centered largely around the computation and compilation by FERA workers of basic data on standardized stand table summary forms. This work does not constitute analysis of the data, but is an essential preliminary step of preparation for analysis. The data, both original and computed, obtained on the thinning plots are numerous and complex and with each remeasurement this condition is accentuated. The preparation of standardized summaries will greatly facilitate the actual analysis of the data, which it is hoped can be started in the near future.

An article on "Thinning Loblolly Pine in Even-aged Stands," based largely on the Urania thinning plots, presented recommendations for thinning in different types of stands, under different economic conditions. The recommendations and conclusions are tentative and may be changed with further experimentation. Until such time as the thinning research has progressed much further than at present, it is hoped that this paper (Occasion Paper No. 35), will serve as a workable guide for thinning.

In April 1934, a set of four thinning plots near Cogdell, Georgia, was destroyed by fire. These plots were established in 1929, in 8-year-old slash pine (above 0.6 inch d.b.h.) in stands with densities of 2,200 and 4,500 trees per acre, which had been thinned to 500 and 300 trees per acre, respectively, with check plots reserved for each. These plots remeasured in the early spring of 1933, following the fourth growing season after establishment. The effects of thinning on diameter growth were very marked. One thinned plot had grown 60 percent faster than the control plot, and the second had grown 32 percent faster than its check plot. Even the second of these differences when tested statistically was found to be highly significant. The height growths, on the other hand, were almost identical, ranging, on the four plots, from 10.0 to 10.5 feet.

Two sets of plots in young second-growth longleaf pine near Loxley, Alabama, were thinned in January, 1934. No other field work was done on this project.

During the last two years thinning plots have been laid out by Latin Square and randomized block field arrangements. Occasionally a break in the uniformity of the forest cover makes it impossible to establish one of the sub-plots, as happened in one set of plots. Furthermore, one or more of the plots may be destroyed by fire or other accident during the life of the experiment. By using a procedure whereby estimates of missing data may be supplied, the missing sub-plot was evaluated and included with satisfactory results. The value of such a method in safeguarding long-term forestry experiments is apparent.

Thinning, particularly in young slash pine stands, is an important and pressing problem in the longleaf-slash pine region of the South. Within the next 10 years, as young stands of slash pine come up under fire protection, the need for knowledge of when and how to thin should increase. It is doubtful if permanent sample plot technique is sufficient to meet the requirements, either in time or in adequacy. For the next few years, considerable effort is planned towards the solution of the problem, at least in part, by special studies entailing temporary sample plots.

Stand Betterment

First-year observations were made at Urania, Louisiana, of the relative effectiveness of deep-notching, double-hacking, and single-hacking in girdling undesirable hardwoods in the course of silvicultural or stand-improvement work. Three experiments involving these three methods of girdling, established in 1933, were re-examined in 1934, with the following results: Of 119 trees girdled by deep-notching in mid-April, 193 93 percent of the 67 oaks and 18 percent of the 52 trees of other specie were dead one year later, in early May, 1934. Of 38 trees girdled by double-hacking in mid-February, 1933, 22 percent of the 23 oaks and none of the 15 trees of other species were dead one year later, in early May, 1934. In both experiments, the oaks were principally post and willow oa and the other species were principally red and black gums. In the third experiment, it was estimated that only one percent of the oaks and none of the other species girdled by single-hacking on 1,250 acres in Septemb November, 1933, were dead in early May, 1934.

These data show that the deep-notching is very much more effective in killing hardwoods during the first year than either of the less thorough methods; that oaks are killed by girdling much more rapidl than are the gums, elms, and hickories; and that fall girdling by single hacking results in negligible mortality, even in the oaks, the following spring. Aside from these indications, first-year observations are no guide to the final effectiveness of the three methods. It should be pointed out that since, in most girdling work, the rate of mortality is usually of little importance in comparison with the total percentage of mortality, the cheaper and less striking methods of girdling may yet pro to be fully as effective, over a period of several years, as the more expensive deep-notching. The actual thoroughness of the cheaper double and single shallow-hacking methods, especially the latter, is difficult to check in the field. Where careless or inexperienced labor is employe single shallow hacking may prove inadvisable. The further mortality of girdled trees in the three experiments discussed here will be observed again in 1935 and each year thereafter until the death of continued life of each girdled tree is clearly established.

The nearly 2,000 hardwoods in the girdling and poisoning studies established in 1929-30, on the Ouachita National Forest in Arkan were re-examined in November, 1934. Analysis of the results was begun immediately, but is not yet finished.

Forestation

During 1934, Wakeley's manuscript on "Artificial Reforestatio in the Southern Pine Region" was edited, revised, and submitted for publication as a technical bulletin. Coincident with the completion of wor on the bulletin, which closed a number of phases of forestation research a sweeping revision and expansion of all forestation plans were made and combined into a 10-year program of forestation studies, designed to fill gaps in existing knowledge and practice, and especially to anticipate an solve the problems that will be encountered in the greatly expanded planting program of the United States Forest Service in the southern sta

In March, 1934, Junior Forester M. A. Huberman was assigned t nursery work at the newly established R. Y. Stuart Memorial Nursery, on the Kisatchie National Forest, Louisiana. The Station built the combined office and residence at the nursery with NIRA funds, and work started with a preliminary series of studies of mortality between the time of sowing and the removal of mulch; of density, of shading, of season of sowing, of nursery soils, of nutrient requirements, and of weeds and chemical weeding.

In the study of mortality between sowing and removal of mulch, it was found desirable to use soil cover instead of burlap mulch, and in the case of longleaf pine, if "pine straw" or burlap mulch be used, to remove the mulch relatively late. In the nutrient studies, the principal result was improvement in technique. The soil studies have furnished the foundation for a comprehensive working plan for fertilizer studies covering the next 10 years. Results from other nursery studies are not yet complete, as measurements must be taken when the trees are lifted and planted for a field follow-up.

In the fall of 1933 a tract on the Kisatchie National Forest was selected for experimental planting. During 1934 this tract, 1,220 acres in area, was fenced, sub-divided by fire-breaks, and mapped, partly by CWA and partly by CCC enrollees. In the fall, a cover map of 900 acres of the tract was prepared, with the 5-foot interval contour map as a base. The first plantations were laid out according to plans coordinated with the 10-year program already referred to and during the seven working days available in December a picked crew of CCC enrollees planted 38,000 trees in grading, mixed species, and spacing studies. This is about-one-tenth of the experimental planting scheduled for the winter of 1934-35.

Little work was done on seed during 1934, other than the preparation of a cone crop estimate for the southern pine region in cooperation with the Society of American Foresters and the CCC. This was the fourth annual cone crop report in which the Station has directly or indirectly had a share, and, as it was based on many more local reports than had ever been received before, it excelled previous reports in both detail and accuracy.

With the help of CCC labor, a small experimental forest nursery was established on the Olustee Experimental Forest. Approximately 10,000 plantable slash pine seedlings will be available this winter. It is planned to use the planting stock to fill in holes in stands on the experimental forest and to provide material for use in other experiments.

One hundred bushels each of slash and longleaf pine cones were obtained through the Osceola National Forest. The seed was thrashed out on the experimental forest and will be used for various purposes in the Station's silvicultural investigations. Part of it will be used in direct seeding experiments.

Nursery work during 1935 is planned to include the installation of a 10-year study of commercial, barnyard, and soil-crop fertilizers; a repetition and expansion of the study made last year of seedling loss between the time of sowing and mulch removal, and a study of weed control.

Planting during 1935 will include the bulk of the 1934-35 planting, about 400,000 trees in all. Of these, by far the greatest number will be in spacing plantations of slash and longleaf pine. Six spacings will be tried, from approximately 4 x 4 feet to approximately 13 x 13 feet, varying the density by uniform stages from 2,500 to 250 trees per acre. Sixty acres of each of these two species will be devoted to these spacings and given complete fire protection; an additional 40 acres of each species will be planted at similar spacing, and burned, under control, at suitable intervals, to test the effect of plantations upon fire hazard, and of controlled burning upon survival, growth, and self-pruning. The spacing plantations are being laid out on a scale sufficiently generous to provide for future thinning plots, with several replications of each thinning method, in each spacing, both burned and unburned. Other plantations scheduled for 1934-35 include those to be used for studies of initial survival after planting, and conversion of oak brush areas to pine. In 1935-36, the survival and oak-conversion studies will be repeated and mixtures of species added. There will also be follow-ups under field-planting conditions of stock grown under various treatments in the nursery.

In the spring of 1935, the 10-year re-examination will be made of 12 acres of experimental plantations at Bogalusa, Louisiana.

Seed studies planned for 1935 include the annual cone crop report and a study of kiln extraction of seed. If personnel is available, a refinement of germination test methods will be undertaken and a start made on a comprehensive study of the relative quality of seed of all species of southern pine from different geographical sources.

Measurements

Southern Pines

A local volume table for second-growth loblolly pine, for cubic feet of solid wood merchantable for pulpwood, was constructed from the measurements made on the methods-of-cutting plots established at Urania, Louisiana, in 1933. The average number of cubic feet per standard cord of pulpwood was found to be 82.5, and the average tree cut into pulpwood had a diameter breast high of 6.1 inches.

The complete taper measurements taken for all pines cut on the Urania thinning plots were plotted on Form 558-a and their individual volumes determined by planimetering. These volumes will be checked against our present volume tables.

A statistical study of the average height growth of second-growth longleaf pine in old-field and in natural stands showed a significant, definite difference in favor of the old-field stands. Between 30 and 40 years of age, where the greatest difference occurred, the mean maximum height of the old-field stands was 8.5 feet greater than the mean maximum height of trees of the same age in natural stands on cut-over areas.

Hardwoods

The analysis of the red gum growth and yield data was completed and a manuscript report of this study prepared.

A continuation of the hardwood growth work in 1935 will depend upon the funds available for this purpose.

Naval Stores

The naval stores industry has experienced one season of production under the control of a Marketing Agreement of the AAA. The Forest Survey made by the Station in the naval stores belt, although not completed, indicates that no shortage of turpentine timber can be expected even with a considerable expansion of markets. Apparently the problem is not how to conserve slash and longleaf pine in order that the South can produce sufficient naval stores, but rather how to integrate naval stores products with the other forest products in order that permanent, local as well as regional, forest industries can be built up and sustained. This calls for planning. Forest management plans involving naval stores must have as their basis woods practice technique, growth figures for turpentining trees, and gum yield tables, and must recognize and evaluate factors that influence naval stores production. The Station's investigations in naval stores management are centered at Lake City, Florida.

Woods Practices

The Starke, Florida, chipping experiments were closed out at the end of the 1934 chipping season. Some of these experiments have been under way since 1923. Important results include the good yields obtained from conservative chipping practice where faces continued up the same side of the tree for a 9-year period, showing that it is possible, without a sacrifice in yield over long periods, to chip trees providing the height of each streak does not exceed one-quarter inch to three-eighth inch. Neither is it necessary to wound a tree deeply to get satisfactory gum yields. The stand of shallow streaked trees, especially those which had had gutters tacked on or inserted in shallow cuts, make a striking comparison with the block of multilated and fallen timber that was cupped in a commercial operation at the same time, but turpentined with deep and high cuts on wide faces, a common method even today, although great progress by the industry has been made in this respect over the last 10 years.

The Station assisted the Florida Forest Service in drawing up general specifications for good naval stores woods practices. They are as follows:

1. Tree Selection

(a) Use of 9-inch minimum diameter limit. (There may be a latitude of 1 - 1½ inch, depending on growth rate of trees. Good 8-inch diameter slash runs 40 barrels per crop of 10,000 faces annually; poor 9½-inch longleaf runs only 35 barrels.)

(b) Eliminate poor trees such as spike topped, badly leaning, and suppressed trees with less than 25 percent crown length.

2. Hanging of Cups

(a) Use rustless or rustfree cups and aprons.

(b) Scribe face widths at 1/3 breast high circumferences and not over 12 inches maximum.

(c) Expose little or no wood below tins.

(d) Set cups level.

(e) Restrict incisions for tins not to exceed the depth of the streak.

(f) Install cups as low as practicable.

(g) Hogals are helpful in preventing heavy slabbing for seating cups.

(h) Gutter chisels or broadaxes and mauls maintain control over the depth of incisions better than free-hand broadaxe strokes.

(i) The pitch of the gutters should be sufficient to keep the gum from clogging.

3. Methods of Working Trees

(a) Height of face shall be from 14 inches to 16 inches each season.

(b) Depth of streak shall be 5/8-inch for slash or 3/4-inch for longleaf; very thrifty timber may be worked deeper for limited periods, but chipping for old or closely grown timber should average 1/2-inch.

(c) The peak angle shall be 130° for the first three years, and not sharper than 90° thereafter.

(d) In the absence of definite knowledge, a square streak is recommended.

(e) Cut streaks weekly between March and October; for exception see (f).

(f) Double streaking is permissible in July and August.

(g) Maintain shoulders at the same level.

(h) Keep chipping tools sharp and well cut out.

(i) Use a chip paddle which covers tins and cup.

(j) Cut an advance streak (if possible during November or December) not later than February 1.

(k) Keep shoulder lines straight.

4. Back Faces

(a) Two faces shall not be worked concurrently, except when early cutting is planned.

(b) If a third face is desired, place a second face only when a four inch and a ten inch bar can be maintained.

(c) At least 4-inch bars shall be maintained between faces.

(d) The rest period depends upon growth, number of faces planned, and final size of tree desired when the last face is worked out. Ordinarily this will be from four to 10 years, if three faces are desired, and a 16-inch tree is wanted after it is worked out for turpentine.

5. Raising Tins

(a) Raise tins preferably yearly depending on economic conditions.

(b) Tack in streaks; or see (c) and (d).

(c) Restrict incisions to 1/4-inch radial depth; or see (d).

(d) Drive tins in jump peaks.

6. Scraping

(a) avoid slabbing wood from faces.

(b) Punching scrape at each dipping is good practice.

(c) Use winged scrape box for low faces and push-up bucket for high faces.

7. Dipping

(a) Dip at least every four streaks.

(b) Where possible dip on two streaks.

(c) A wood dip paddle is recommended for zinc, aluminum, and painted cups.

8. Supervision

(a) Close supervision for best work is essential.

(b) Inspect periodically and rate the work of woods riders for comparison.

(c) Keep records of production and costs per crop.

The field work in the "Interval of Chipping Study" was transferred from Starke to Olustee in 1934. The main object of the present experiment is to determine the effect on the vitality of the tree of taking advantage of the maximum number of streaks as indicated by average weather conditions throughout the year. Previous studies involving weather relationships with yield enable the selection of chipping intervals that are likely to give the best yield if the possible ill effects of many streaks are ignored.

Naval Stores and Fire

This project, dealing with effect of annual fires on gum flow in trees being worked for naval stores, has progressed along two distinct lines. These are: (1) Direct effect of fire on the tree; and (2) the indirect effect on the tree from soil changes associated with fire

The effect of defoliation by fire on gum flow in longleaf pine was found to reduce the yield by about 50 percent for the first season in the case of complete defoliation, and small amounts in the case of partial defoliation. Crown burning was done in March. The yield declined quite rapidly (temperature influence allowed for) from time of burning until June, at which time it gradually increased. Since the new foliage was quite apparent in June, it is likely that the pick-up in yield is connected with its functioning. The recovery in yield appears to be closely related to the extent of crown recovery after a fire. The study indicates that it would be well to delay the resumption of turpentining for a season following a spring or summer fire if considerable defoliation resulted.

Study of the indirect effect of fire through soil changes has been made by determination of physical and chemical differences in soils subjected to frequent fires as contrasted with soils protected from fire. Site factors favorable to tree growth are likewise favorable for increased gum flow, since a positive correlation exists between growth rate and gum flow. Favorable soil conditions may, therefore, be expected to be beneficial to gum production. Detailed sampling and chemical analysis of soils from eight study areas throughout the longleaf pine region were made. This work showed conclusively that the soils from burned areas had higher pH values (less acid) and high percentages of replaceable calcium and of total nitrogen. They also showed a higher loss on ignition. These data indicate that burned soils contain more organic matter than unburned soils. An explanation of this apparent anomaly is afforded by the marked difference in ground cover and forest floor of burned and unburned areas. Burned areas are characterized by a much more numerous, as well as a more diverse ground cover than unburned areas. This is due to the smothering effect of litter as it accumulates over a period of years. The diversified ground cover of burned areas, in which leguminous plants occur in abundance, appears to be more effectiv in increasing organic matter and nitrogen than does litter. Supplementary studies on organic matter are now being made. The changes in acidity and in replaceable calcium are attributed to formation of ash following fire.

In order to determine whether the chemical changes in forest soils associated with fire are significant in tree growth, slash pine seedlings were grown (from seed) for approximately three months in portions of the same soil samples analyzed chemically. In seven out of eight cases, seedlings in the soils subjected to fire were taller and heavier than seedlings in soils protected from fire. These differences ranged up to 19 percent. The soils used were sifted and stored for several months prior to the time of the actual experiments. Physical factors, including moisture and structure, were controlled; hence the differences in seedling development were entirely due to chemical alterations in the soil, the end products of possible bacterial activity being considered as chemical characteristics. In order to evaluate any differences in bacterial activity in the soils being considered,a study is in progress involving ammonifying and nitrifying capacity.

Recognizing that differences in physical characteristics of soils from burned and unburned areas might also differ, a study has been undertaken to evaluate any differences in the following: Penetrability, volume weight, water-holding capacity, and wilting coefficient. Differential counts of the soil fauna are being made and nottes obtained on the intensity of their activity in the field. This phase of the study is being conducted in cooperation with the Florida Agricultural Experiment Station. Germination of slash and longleaf pines on soils from a burned and unburned areas is also being studied. Furthermore, pine seedling growth in soil collected in undisturbed field condition is being determined.

Gum yields for the second year of faces from a three acre burned plot when compared with a matched three acre protected plot showed a slight difference in yield in favor of the burned plot. However, the detailed analysis is not yet completed, so it is not known yet whether the difference is significant. The first year's turpentining took place in 1933, with the plots under protection since 1931. In February, 1934, one of the plots was burned over lightly, taking care to do as little damage to the trees as possible.

Erosion-Streamflow

During the year erosion-streamflow studies pertaining to the Mississippi loessial region were continued at Holly Spring, Marshall County, Mississippi. The Station's studies under this project fall under two broad classes: (1) studies dealing with the control of erosion through revegetaion measures; and (2) studies dealing with factors affecting soil and water losses from representative classes of land.

Erosion Control Studies

The erosion control studies are considered the most important phase of the project in view of the fact that in this region erosion is widespread and of an especially destructive character. There is particular need for cheap and effective control of erosion such as is provided by trees and other vegetation, but there are many problems to be solved in establishing a satisfactory plant cover on impoverished eroded sites. Research data applying to such work are in special demand at the present time, as extensive erosion control plantings are being made throughout the loessial region under the Emergency Conservatio Work program. The establishment of a National Forest near Holly Springs, Mississippi, has also heightened the demand for information pertaining to planting of eroded lands and the future use and management of reclaimed areas.

Starting in 1931, the Station has each year established experimental plantings of trees and other vegetation on gullied and sheet-eroded areas. In 1931, six areas of about one acre each were planted in Adams, Franklin, Carroll, Lafayette, Marshall, and DeSoto Counties, Mississippi. Since then, the work has been concentrated in Marshall County, near Holly Springs, and to date approximately 20 acres have been planted to more than 28,000 trees. The areas have been kept under detailed observation and the trees examined and measured annually.

These erosion control plantings are grouped under three genera types of study, namely; (1) Tests of various site preparatory measures; (2) comparative tests of tree and plant species to establish the suitability of each for erosion control; (3) tests to develop more effective planting technique. Tree species planted are: Black locust, southern red oak, Nuttall oak, white oak, Chinese elm, sweet gum, catalpa, sycamore, white ash, cottonwood, willow, sassafras, persimmon, shortleaf pine loblolly pine, slash pine, Austrian pine, ponderosa pine, and red cedar. Herbaceous species tested are: Bermuda grass, Dallis grass, Johnson grass carpet grass, red top, orchard grass, Kentucky blue grass, kudzu, Japanes honeysuckle, crotalaria, sesbane, and several species of lespedeza. The planting technique studies deal with such factors as classes and grades of planting stock, planting season, methods of planting, sites, and such cultural treatment as cultivation, pruning, etc.

During 1934, a black locust nursery was established at Holly Springs to supply 1-0 stock suitable for erosion control field planting. At the same time various nursery problems relating to the production of black locust nursery stock were studied. Comparative tests were made to determine the effect of depth of sowing, rate of sowing, seed inoculation source of seed, seed treatment, sowing methods, etc. Some of the tests have furnished data on the relation between field germination and seedlin yield of black locust. Thus in 16 tests of 100 seeds each, using 4 lots of seed, average germination in 15 days in moistened cloth rolls was 87 percent; in watered sand flats, 52 percent of the seed germinated. When sown in the nursery in a silty clay loam, germination averaged 34 percent whereas only 19 percent of the seeds produced nursery seedlings. Numerou other field tests, some of which were carried out under favorable conditions, furnished data indicating that a rather low seedling percent is the rule rather than the exception in similar field sowings of black locust and that this factor must be given proper consideration when estimating quantities of seed to sow in relation to expected seedling production.

During the year a sulphuric acid treatment was developed to increase the germination of black locust seed and the effectiveness and practicability of the method was demonstrated in numerous tests. Comparative tests indicate that germination of acid-treated seed is in general markedly superior to that of seed soaked in hot water. Furthermore, the acid treatment has an added advantage in that seed so treated may be thoroughly dried and kept for a considerable period without appreciable loss in germination capacity. In field tests with four lots of seed, acid-treated seed produced on an average from 1.7 to 15 percent more seedlings than did untreated seed. In more extensive nursery sowings of the same lots the acid treatment approximately doubled the seedling crop. Based on the Station's recommendation, the Mississippi Forest Service treated two tons of black locust seed for use in nurseries in northern Mississippi which supply seedlings for erosion control work being done by the CCC.

Run-off and Erosion Studies

The studies dealing with factors affecting soil erosion and surface run-off are being carried on under several sub-projects. A two-year study of soil and water losses from seven representative types of cover and land use in northern Mississippi was completed in 1933, and during 1934 a manuscript reporting the results was prepared. The data, reported in the Station's last annual report, revealed that surface run-off and erosion from mature oak forests are almost negligible compared with huge losses from barren old-field or cultivated lands. In connection with these experiments, a study has also been carried on since 1931, to determine the effect of annual fires on surface run-off and erosion from small plots located in oak forests and broomsedge grassland.

Another experiment was started in 1931 to study the effect of applying forest litter to a severely eroded soil. Two plots (3 x 12 ft.) were established on a barren slope with a 10 percent gradient in an abandoned field. Run-off and erosion from the plots were measured after each rain during a preliminary period of one year. At the end of this period, 41 pounds (oven dry weight) of forest litter, obtained from a 3 x 12 foot plot in an adjacent oak forest, were applied to the surface of one of the plots and subsequent soil and water losses measured. The data show that the addition of forest litter decreased run-off from one year's precipitation by more than half and reduced soil losses to 1/88 of the amount formerly lost. The results indicate that forest litter contributes greatly to ground storage of rainfall even when the underlying soil was in an extremely compacted and unabsorptive condition. Thus in four heavy rains, ranging in quantity from 2.32 to 6.23 inches, the litter-covered soil absorbed from 32 to 88 percent more rainfall than did barren soil. In general, the results confirm earlier findings that the capacity of forest litter to absorb rainfall is of little consequence compared with its ability to increase absorption of water by the soil. The results also emphasize the importance of reforesting similar eroded soils and building up and maintaining an adequate ground cover.

Surface run-off and erosion is also being measured from two small gullies, using settling tanks in which to catch eroded soil and weirs and recording devices to measure run-off. This study has been under way since 1932. Early in 1935, the areas will be planted to trees and other vegetation and the degree of control measured thereafter in terms of soil and water losses.

In connection with the latter study, other factors which augment or check erosion and runoff from the two areas are being investigated. Quantitative data from the study supplemented by observations show that frost is a most potent factor, causing soils in this region to disintegrate and erode, and that soils need not actually freeze in order to be affected. Thus, in two instances, ice needles formed on the surface of unfrozen soils and increased erosion from one area roughly four and eight times, respectively, and from the other area nine and 45 times, respectively.

Financial Aspects of Private Forestry

County surveys of forest and economic conditions throughout the South have shown that the shortleaf-loblolly pine-hardwood forests and the longleaf-slash pine naval stores forests in the southeastern United States are more favorably situated for sustained yield forest management than the other forest regions of the South. Investigations of individual properties have shown a general lack of information on forest yields and an absence of records of costs and returns from forest managed for sustained yield. Efforts during 1934 have, therefore, been concentrated on those problems which are most vitally concerned with sustained yield forest management in these two forest regions.

In shortleaf-loblolly pine-hardwood forests natural reproduction is abundant and stands are commonly composed of both pine and hardwood trees of many sizes. Logging, as practiced in this region, has generally removed the larger trees, but a fair stand of poles, saplings, and seedlings is usually present also and these make up the potential sawtimber crops of the future. Selective logging, which removes financially mature trees, provides for future cuts, and improves the stand by removing all trees not useful for further growth, offers an excellent means for obtaining sustained yield. In order to investigate the financial aspects of selective logging, a virgin pine stand which showed an annual increment of 400 board feet per acre per year, or a possible cut each ten years of 4,000 board feet, was marked and is now being logged selectively. It was found that a breast height diameter of 24 inches could be established as a minimum, but in addition defective, unthrifty, and other undesirable trees of smaller diameters are being removed. Costs and returns are being kept and will be compared with those incurred when logging more than double this volume per acre under the usual logging practice. It now appears that a cut each 10 years of high quality timber will be feasible and profitable.

In second-growth pine the volume in trees of larger sizes is often absent or very limited. To determine the financial possibilities of cutting small volumes per acre and at the same time improving the stands by cutting trees undesirable for future growth, several blocks of second-growth pine have been selected and marked for cutting, with the volumes to be cut varying from 500 to 4,000 board feet per acre. About half of these blocks have been cut and the logs removed by truck; the remainder will be cut next spring. Pulpwood is being cut from tops. Timing and cost studies are being made for each block and the returns from the logs will be obtained by a mill scale study. Although complete costs are not yet available, the study indicates that it is feasible to log small volumes per acre and to utilize pulpwood from tops.

In order to determine costs and returns from actual sustained yield forest management, a large portion of the Crossett Experimental Forest, consisting of second-growth shortleaf-loblolly pine and hardwoods, has been set aside for this purpose. A careful inventory and growth study has been made and thinnings, improvement cuttings, and a harvest cutting on a portion of the area will be made during the coming year. A ledger of all costs and returns will be kept.

In the naval stores region, a very important problem in forest management has to do with the removal and utilization of worked-out turpentined trees in order to make room for future tree crops. Timing and cost studies and inquiries as to returns from utilization of worked-out trees for pulpwood and for staves and headings were made during 1934. Studies of many other possible forms of utilization will be made during the coming year, in order to show the most profitable utilization for various sizes of worked-out trees.

In determining the possible yields and financial aspects of stands handled for a sustained yield of naval stores, an area of 500 acres in southern Georgia, which has restocked to an excellent stand of slash pine saplings under 15 years of fire protection, was selected. On this area an intensive inventory, growth analysis, and study of gum yields have been made and costs and returns from naval stores and from other forest products have been determined. Future yields under sustained yield management and the financial aspects of such management can be predicted. These will be checked against the actual results obtained by the owners, following the recommended plan of forest management.

The interest of the lumber industry in selective logging and in sustained yield management and the activities of the naval stores industry in controlling production have greatly increased the demands for the results of the Station's Financial Aspects projects. These projects will be pushed to completion as rapidly as possible and results will be made available through trade journals and multigraphed articles.

New Public Domain

The chief accomplishment during 1934 in the New Public Domain project was the completion of a manuscript entitled "The Problem of Forest Land Tax Delinquency in Arkansas." It is planned to have this manuscript published by the Arkansas Agricultural Experiment Station, which cooperated in the study. The chief conclusions of this study are:

1. The chief cause of tax delinquency on forest lands in Arkansas is the mismanagement of the forest resources on which the productivity of the properties depends.

2. The most important secondary cause is the existence of unsound laws governing procedure in taxation and the maladministration of these laws, making of deliberate delinquency an easy method of tax-evasion or tax-reduction.

3. On most forest properties not denuded the annual tax per acre in Arkansas is not excessive nor above a fair percentage of market value of the property.

4. Some solution should be found for the problem of confisca tory drainage and levee taxes in the Delta portion of the state.

5. Owing to the conditions and practices noted under (2), the State of Arkansas cannot confirm its title to a single acre theoretically forfeited to it for non-payment of taxes and hence cannot develop and improve them for public purposes.

An estimate of the extent of tax-forfeited lands in the South was obtained in connection with the preparation of the Forest Service Report to the National Resources Board. These data, as of January 1, 1934, give the area which has been certified to public title or that which should be so certified if statutory provision were properly enforced. The estimates follow:

State	Total land area reverted	Forest area reverte
	Acres	Acres
Ala.	181,000	80,000
Ark.	1,448,000	965,000
Fla.	12,192,000	7,925,000
Ga.	40,000	25,000
Miss.	1,250,000	750,000
La. 1/	1,854,000	972,000
Okla. 1/	2,820,000	2,500,000
Texas	3,493,000	2,620,000
Total	23,278,000	15,837,000

1/ - Forested area.

In order to provide a basis for future land-planning studies by both the Forest Survey and the miscellaneous economic projects of the Station, the Forest Survey and New Public Domain staffs inaugurated joint in October a survey of land-ownership, tax delinquency, valuation, taxation, and public finance of sample counties in Survey Units Georgia

No. 1 and Florida No. 1. Three counties in each unit have been completed: Clinch, Coffee, and Dodge Counties, Georgia; and Madison, Nassau, and Volusia Counties, Florida.

The work planned for 1935 includes the completion of the joint Survey-Public Domain project in Units: Georgia No. 1 and Florida No. 1, by sampling three or more additional counties in each unit, and the expansion of this project over other Survey Units as rapidly as funds become available. In addition, cooperation will be continued with the several states, with the State Land-Planning Consultants of the National Resources Board, and with the Regional Office of the Forest Service on problems of land use, tax-delinquency, and forest taxation.

Forest Survey

In January 1934, the field and office force of the Forest Survey numbered fourteen field crews of three men each, four field supervisors, one field manager, a computing chief, two computers, two stenographers, and a New Orleans executive staff of two persons. At the end of 1934, the Survey force numbered 83 field men, a field manager, four field supervisors, a computing chief, a computing and office force of 26 persons, and two executive officers.

The broad general program of the Survey contemplates the completion, before April 1, 1935, of the field work in the naval stores belt of the Atlantic and Gulf Coastal Plains, the entire Mississippi River Delta region from Illinois to the Gulf, the loblolly-shortleaf pine belt in Mississippi, and the Norris Dam drainage basin in Tennessee and Virginia. This total area to be completed is in the neighborhood of 100 million acres.

Against this program the Survey has covered with its line plot work during 1934, 67 million acres. The following tabulation shows the status of the work as of December 31, 1934:

Progress Report: Forest Survey in the South
January 1, 1935.

Survey unit	Total area	Date field work begun	Date field work completed	Area completed to December 31,1934	Estimated percentage of office analysis completed December 31, 1934	Report publis
	Thousand acres			Thousand acres		
ALABAMA Unit #1 (Naval Stores)	4,500	Aug.,1934	Dec.,1934	4,500	40	None
ARKANSAS Unit #1 (Bottom-land Hdwd.)	6,000	Aug.,1934	-	4,409	0	None
ARKANSAS[1/] Unit. #2 (Bottom-land Hdwd.)	6,300	Nov.,1934	-	880	0	None
FLORIDA[2/] Unit #1 (Naval Stores)	9,516	Dec.,1933	July,1934	9,516	85	None
FLORIDA Unit #2 (Naval Stores)	6,900	June,1934	Nov.,1934	6,900	55	None
GEORGIA Unit #1 (Naval Stores)	9,643	Dec.,1933	June,1934	9,643	85	Four releases.
GEORGIA Unit #2 (Naval Stores)	6,000	Apr.,1934	July,1934	6,000	85	None
LOUISIANA Unit #1 (Bottom-land Hdwd.)	4,000	Nov.,1933	Oct.,1934	4,000	40	None
LOUISIANA Unit #2 (Bottom-land Hdwd.)	10,945	Sept.,1934	-	5,087	0	None
LOUISIANA Unit #3 (Pine-Hdwd.)	6,500	Dec.,1934	-	696	0	None

Survey unit	Total area	Date field work begun	Date field work completed	Area completed to December 31, 1934	Estimated percentage of office analysis completed December 31, 1934	Reports published
	Thousand acres			Thousand acres		
MISSISSIPPI Unit #1 (Bottom-land Hdwd.)	4,420	Jan., 1932	Aug., 1932	4,420	100	Preliminary Survey Report
MISSISSIPPI Unit #2 (Pine-Hdwd.)	8,188	Feb., 1932	Apr., 1933	8,188	70	None
MISSISSIPPI[3/] Unit #3 (Pine-Hdwd.)	13,011	May, 1933	-	2,406	0	None
MISSISSIPPI[4/] Unit #4 (Naval Stores)	6,500	Dec., 1934	-	5,994	20	None
SOUTH CAROLINA Unit #1 (Naval Stores)	4,000	May, 1934	Aug., 1934	4,000	75	None
TENNESSEE-VIRGINIA (Upland Hdwd.-Pine)	1,850	Mar., 1934	Aug., 1934	1,850	75	None
TEXAS Unit #1 (Pine-Hdwd.)	8,500	Aug., 1934	-	6,622	20	None
TOTAL	116,773			85,111		

1/ Arkansas Unit #2 (6,300,000 acres) includes approximately 3 million acres in the bottom lands of Missouri and Tennessee.

2/ Excluding Ocala National Forest.

3/ Mississippi Unit #3 includes 1,010,000 acres in the loblolly pine type of eastern Louisiana.

4/ Mississippi Unit #4 includes approximately 2 million acres in the naval-stores belt in eastern Louisiana.

One of the outstanding Survey accomplishments of the year has been the perfecting of a system of office computation equal to the task of handling the tremendous volume of field data that is steadily being gathered. This system involves the use of electric sorting and tabulatin machines and has been arranged so that the machines do most of the routin summary work. This battery of machines has been established in our own office and is being operated by members of the Survey force.

During the year a special economic study of the gum naval stor industry was organized and the field work completed. This study covered all of the active naval stores belt. In addition to this work other special studies have been organized and in part completed, as follows:

1. The quantity of wood used as fuel.
2. The quantity of wood used in the curing of tobacco.
3. Studies of the lumber manufacturing plants, their number, size, character, and annual output.

During 1934 definite plans for the presentation of Survey information, in the form of advance releases, preliminary reports, and fina reports, have gradually developed. The reports already issued for individual Survey Unit include:

Occasional Paper No. 31, "The Forest Survey in the South," (Revised December 31, 1934).

No. 34, "The Proportion of Diameter Classes in the Longleaf-Slash Pine Stands of Southeast Georgia."

No. 36, "Classification of Working Turpentine Cups in South Georgia by Year of Working and Turpentine History of Worked Trees."

Forest Survey Release No. 4, "Gum Naval Stores Production, Producing Acreage, and Number of Working Cups in Forest Survey Unit No. 1, Georgia."

Forest Survey Release No. 5, "Advance Information on the Supply of Pulpwood in Survey Unit No. 1, Georgia.

No. 6, "Preliminary Report on the Forest Surve of the Bottomland Hardwood Unit in Mississippi."

Forest Pathology

Pine

The investigation of the brown-spot needle disease (Septoria Acicola) of longleaf pine seedlings continues as the main project. This study is divided into two separate investigations. The first concerns the effect of the disease on seedling development; the second involves the effect of fire as a method of disease control. Other assignments deal with a study of methods of slash disposal.

To gauge the effect of the brown-spot needle blight on seedling growth, control of the disease is essential and has been accomplished by spraying at frequent intervals. One set of experiments is being conducted in a densely stocked area of natural reproduction near Bogalusa, Louisiana. When continued over a period of years, the cumulative dwarfing effect of the disease is indicated by consistently better growth of sprayed seedlings as compared with that of unsprayed and infected plants located on alternate plots. Another spraying test involves nursery-grown seedlings and is designed to eliminate the variations encountered when working with natural reproduction. By the end of the sixth season in the field treated seedlings averaged 56 inches in height, while the height of the unsprayed diseased seedlings was 3.6 inches.

Studies dealing with the influence of fire as a measure of disease control were continued, as the problem involves a fundamental policy in forest management in the longleaf pine region.

A study was initiated dealing with the spread of the disease in an area of longleaf pine reproduction following a single fire. The fire occurred in February 1933, and by the following October infection within the burned area was greatest in a 100-foot zone adjoining the unburned margin where diseased seedlings supplied sources of reinfection. A general, but appreciably lower, infection existed over the rest of the burned tract. The amount of disease within the "burn " varied from one-seventh to one-half of that on seedlings outside of the fire-swept area.

Slash Disposal Methods

A study of the rate of decay of shortleaf pine logging slash on the Ouachita National Forest was completed. The main purpose of the study was to compare different methods of slash disposal by determining the rate of decay of shortleaf pine logging slash when (1) piled in tepees; (2) lopped and scattered; and (3) left intact. On a fourth area the slash was piled and burned. A second object of the study was to determine what species of fungi were mainly instrumental in decaying the logging slash.

For the given forest type and locality, decay of slash when left intact is essentially as rapid as that of slash lopped and scattered. Piling of slash is both expensive and retards the rate of decay. Piling and burning of slash is more expensive than lopping and scattering. The advantage of immediate elimination of the fire hazard is balanced by creating unfavorable soil conditions beneath the piles that retard seedling establishment.

Only two species of fungi, Lenzites saepiaria (Wulf.) Fr. and Polystictus abietinus (Dicks.) Fr., were important factors in the process of decay. They caused at least 70 percent of the observed decay.

It was concluded that the best method of slash disposal in the shortleaf-hardwood forest is simply to leave the slash intact. In practice, this method should be modified by moving tops far enough away from seed trees or valuable reproduction to reduce or eliminate the fire hazard for the residual stand.

Nursery Diseases of Locust

Experimental work dealing with control of nursery diseases of black locust was initiated during the year. The greater part of the work was done by Howard N. Lamb, Technician, temporarily assigned to the Bureau of Plant Industry at the Southern Forest Experiment Station. Extensive tests involving soil disinfection and seed treatment were conducted in cooperation with State nurseries and other agencies in Louisiana and Mississippi. The greater part of the losses at the Louisiana nursery were due to chemical injury, insect girdling, heat, and drought. During the course of the work the interesting discovery was made that much seedling loss was due to stem girdling caused by a tree-hopper or membracid, a previously little known insect. At the Mississippi nursery losses were due mainly to root rot, nematodes, damping-off, and heat injury. Heat and drought injury were particularly severe where seedlings were planted at both localities after the middle of June.

To control damping-off, seed treatments were conducted at three localities. The tests indicated very little damping-off existed at the Louisiana nursery. In one Mississippi nursery, losses caused by drought, insects, and nematodes gave inconclusive results. Copper carbonate and zinc oxide seed treatments gave favorable results in a second Mississippi nursery.

Forest Products Pathology

The major emphasis in Forest Products Pathology during 1934 has continued to be the development of adequate means of preventing sap stains and molds in domestic and export lumber, logs, and other forest products. Special considerations were given to three small-mill treatments which might influence the effectiveness of dipping. These three practices were bulk-piling, delayed dipping, and hand dipping the lumber. On the basis of the tests run, it was concluded that dipped greem lumber could be bulk-piled for as long as four weeks, provided adequate cover was given to the piles. Where rain-washing occurred, the results were less reliable than for protected piles. The importance of proper roof cover for the regular lumber piles was also noted. No treatment has yet been found which will withstand extensive rain-washing. It is essential, therefore, to have a roof over the completed seasoning pile, such a roof constructed so that it will not obstruct the passage of air over the top of the pile.

Delayed dipping was studied and the results showed that more than two days' delay in dipping pine lumber which was subsequently seasoned under conditions suitable for the development of stain should be particularly avoided. Where insect damage was present in the log at the time of sawing, a delay of one day allowed 50 percent of the lumber surface to stain.

Cost studies on hand-dipped lumber showed that the lumber could be dipped for an average solution cost of 16 cents per thousand board feet, if proper procedures were followed. The striking fact brought out by this phase of the study was that where careless dipping procedures were followed, the cost could be more than doubled.

Small-scale tests for the year disclosed no chemicals better than the organic mercury/and chlorinated phenol compounds. Certain improvements in composition or combinations were noted, but the results will need to be verified on large-scale commercial tests.

The testing of sprays for the prevention of log deterioration did not reveal any sap stain preventives better than those already known, but one phenol compound seemed to have insect-repellent qualities as well as being a fair sap stain preventive.

Studies have been started on the mode of sap stain dissemination in lumber yards. Spores have been isolated from the air around each step of the lumber production process, from the log saw to the lumber stacks. This phase of the study suggests that the spores are ever present, and that wind dissemination alone might account for much infection. Observations after one week of sticks caged to prevent insects larger than mites from gaining access to the sticks showed heavy stain, thus suggesting again that wind-borne inoculum may be sufficient to cause stain.

Looking forward to a possible quantity production of newsprint paper from southern pines, it seemed desirable to anticipate any difficulties which might be encountered in maintaining the pulpwood in a sufficiently well-preserved condition, from the time of cutting until its utilization, so that neither the yield nor the quality of the pulp would be impaired, or the cost of production otherwise increased. As a part of an investigation of this point, observations were made at seven pulp and paper mills in the western portion of the southern pine producing region. The results of these mill contacts in the section visited indicate that long periods of storage are unnecessary. A steady supply of freshly cut pulpwood was usually obtained without difficulty, even during the winter months. An important fact brought out by the investigation was that every precaution should be taken to insure the proper perpetuation of the pulpwood supply, so that the present practice of year-round cutting can be continued.

The work in Products Pathology for 1935 will center around (1) the determination of the factors which are important in spreading sap stain in the mill yards and (2) further application of our present stain prevention knowledge to common mill practices.

Forest Entomology

Forest Tree Insects

For use in forest insurance studies by the United States Forest Service, a liability chart was prepared showing the potential insect damage to pine forests in the Gulf States, such as injury by barkbeetles and turpentine borers. This chart not only shows past depredations, but also indicates what may be expected in the future. It is believed that the Gulf and South Atlantic States Region will be comparatively free from serious barkbeetle epidemics.

There were no serious outbreaks of forest tree insects in the South in 1934.

During 1935, if the rainfall is deficient, careful watch must be kept for outbreaks of Ips barkbeetles, where there have been cuttings, slashings, windfalls, or fire. Special studies of pine cone insects will be made, with particular reference to 1-year-old cones.

Nursery Insects

Two insects attacking crops, namely the alfalfa hopper and the lesser corn borer, not previously known to attack forest growth, were found to seriously injure and kill young black locust seedlings by girdling where these seedlings were grown in large numbers in nurseries in Louisiana, Mississippi, and Arkansas. In cooperation with the Office of Forest Pathology, Bureau of Plant Industry, studies of the biology and control of these insects were conducted.

A census of white grubs and adults was made for the Gulf States in 1934. Reports were received on 13 species of insects, but the damage caused during the year by these insects in forest nurseries was slight. Carbon bisulphide emulsion has been proven to be an effective method of control and should be on hand at all forest nurseries, but must be used with precaution.

Tip moth injury to pine seedlings in forest nurseries during 1934 was slight. If the damage appears to be serious when the stock is pulled, a chemical dip, which should always be on hand at all forest nurseries, should be used.

Cutworm injury to seedlings in forest nurseries during 1934 was not serious in the Gulf States. Materials for preparing poison baits, according to the directions given in U.S.D.A. Leaflet No. 2, should be on hand at all times, but should not be made up until needed.

As a result of rearing work in 1934, 24 different species of pine cone insects have been reared. A primary parasite of one of the most serious insects has also been found.

A census of white grubs and adults will again be made in 1935. If damage becomes serious, biologic studies will be conducted on the principal species involved.

Intensive studies of black locust nursery insects and their control will be conducted.

Forest Product Insects

In cooperation with the Office of Forest Pathology, Bureau of Plant Industry, and various chemical companies throughout the country, tests of chemical sprays to protect green logs and lumber from ambrosia beetle attack have been conducted at Crown Point, Louisiana. A few of these chemical sprays show some promise and further tests will be made in an effort to combine an insecticide with a sap stain preventive.

In cooperation with the Forest Products Laboratory, tests of chemical wood preservatives will be conducted, to supplement the tests being conducted in Panama, in an effort to discover new chemicals which will protect wood from termite attack.

In addition to the above, studies of miscellaneous forest insects will be made as opportunity offers and particular attention will be paid to insects heretofore not regarded as forest pests and also those which are apparently entirely local.

This is an entirely tentative program and a serious outbreak of any one insect might result in practically all time and efforts being spent in its study and control.

Plans for 1935

One of the chief activities of the Southern Station during 1935 will be the further development of the present experimental forests in Florida, Mississippi, Louisiana, and Arkansas, and the inauguration and active prosecution of studies in several main fields of forest research on these areas. The Forest Survey will be pushed towards completion as rapidly as funds permit. The Survey expects to complete taking of line-plot data on a total of 117,000,000 acres by April 1, 1935, leaving about 200,000,000 acres yet to be covered. All other regular research projects of the Station will be pushed forward as rapidly as available funds permit. Current Station findings will be made available to other agencies and to interested parties through formal publications and by Occasional Papers and Notes multigraphed at the Station.

ARTICLES PUBLISHED OR SUBMITTED FOR PUBLICATION

January 1, 1934 - December 31, 1934.

Bull, Henry	- "Profit from Improving a Second-Growth Forest of Loblolly and Shortleaf Pines and Hardwoods Occasional Paper No. 38. December, 1934.
Craig, R. B.	- "Reversion of Forest Land Increasing in the South." Service Bulletin 18 (21): 3-4. Occasional Paper No. 32. July, 1934.
David, Wm. P.	- "Color Variations in Ponderosa Pine Oleoresins Journal of Forestry, 32 (5): 609. May, 1934.
Demmon, E. L.	- "The Opportunity for Forestry in Southern Agri culture." Address delivered at annual meetin of Association of Southern Agricultural Worke Memphis, Tenn., February 1, 1934. Occasional Paper No. 30. February, 1934.
________	- "The Place of the Naval-Stores Industry in Southern Agriculture." Address delivered at the spring meeting of the American Chemical Society, St. Petersburg, Fla., March 27, 1934 Weekly Naval Stores Review 44 (5): 8,12. 193 Occasional Paper No. 33. August, 1934.
Forest Survey Staff	- "Advance Information on the Supply of Pulpwood in Survey Unit #1, Georgia." Forest Survey Release No. 5. November 17, 1934.
________	- "Classification of Working Turpentine Cups in South Georgia by Year of Working and Turpentin History of Worked Trees." Weekly Naval Stores Review 44 (30): 6. 1934. Occasional Paper No. 36. October, 1934.
________	- "Gum Naval Stores Production, Producing Acreage and Number of Working Cups in Forest Survey Unit #1, Georgia." Forest Survey Release No. (previous releases issued as Occasional Papers 31, 34, and 36). November 1, 1934.
________	- "Preliminary Report on the Forest Survey of th Bottom-land Hardwood Unit in Mississippi." Forest Survey Release No. 6. November 30, 193
________	- "The Proportion of Diameter Classes in the Long leaf-Slash Pine Stands of Southeast Georgia." Occasional Paper No. 34. August, 1934. Weekl Naval Stores Review 44 (22): 6. September 1,19

Forest Survey Staff - "The Southern Forest Survey." Weekly Naval Stores Review 44 (14): 12. July 7, 1934; Occasional Paper No. 31. June 1, 1934.

Foster, Ellery - "The Use of Aerial Photographs in Mapping Ground Conditions and Cruising Timber in the Bottomlands of Mississippi." Occasional Paper No. 37. November, 1934.

Heyward, Frank - "Comments on the Effect of Fire on Feeding Roots of Pine." Weekly Naval Stores Review 44 (19): 4. August 11, 1934.

______________ - "Needle Browning in Longleaf and Slash Pines during the Late Summer." Weekly Naval Stores Review 44 (31): 12. November 3, 1934.

____
and
Barnette, R.M. - "Effect of Frequent Fires on Chemical Composition of Forest Soils in the Longleaf Pine Region." Florida Agricultural Experiment Station Bulletin 265. March, 1934.

Huberman, M. A.
and
May, J. T. - "Sampling the Forest Nursery." Journal of Forestry 32 (8): 1017-1019. December, 1934.

Liefeld, T. A. - "Effect of Frequency of Chipping on Naval Stores Yields in Second-Growth Longleaf Pine." Naval Stores Review 44 (11): 12. June 16, 1934.

Meginnis, H. G. - "Effect of Cover on Surface Run-Off and Erosion in the Loessial Uplands of Mississippi." To be published by Department. January 8, 1934.

______________ - "Influence of Forest Litter on Surface Run-Off and Soil Erosion." Presented at meeting of American Soil Survey Association. November 22, 1934.

______________ - "Influence of Frost on the Erosion of Loessial Soil in Northern Mississippi." To be published.

______________ - "Methods of Increasing the Germination of Black Locust Seed." To be published by Department. December 17, 1934.

______________ - "The Effect of Cultivating Young Black Locust." Journal of Forestry, 32 (5): 569-571. May, 1934.

Olsen, C. F. - "Notes on Black Locust Pod Collection, Seed Extraction, and Seed Cleaning." Journal of Forestry, 32 (1) : 97-98. January, 1934.

Pessin, L. J. - "Annual Ring Formation in *Pinus palustris* Seedlings." American Journal of Botany 21 (9): 599-603. November, 1934.

__________ - "Effect of Flower Production on Rate of Growth of Vegetative Shoots of Longleaf Pine." Science 80 (2077): 363-364. October 19, 1934.

Reynolds, R. R. - "Volume Tables to Fixed Top Diameters." Journal of Forestry, 32 (1): 29-31. January, 1934.

Scheffer, T. C. - "Dipping for Control of Sap Stain at Small Pine Sawmills." Southern Lumberman, 149 (1883): 109-116. September 15, 1934.

__________ and Chapman, A.D. - "Dipping Tests for Control of Sap Stain, Mold, and Decay in Southern Lumber and Logs." Southern Lumberman, 149 (1881): 37-40. August 15, 1934.

Siggers, P. V. - "Observations on the Influence of Fire on the Brown-Spot Needle Blight of Longleaf Pine Seedlings." Journal of Forestry, 32 (5): 556-562. May, 1934.

Southern Forest Experiment Station - "Southern Forestry Notes" - Nos. 5, 6, 7, 8, March, May, July and September, 1934. Multigraphed for limited distribution.

Wackerman, A. E. - "Allocating Cutting Budgets by Means of a Forest Sky Line Graph." Journal of Forestry, 32 (1): 4-7. January, 1934.

__________ - "Subsistence Homesteads and Sustained-Yield Forestry in the South." Southern Lumber Journal, 38 (11): 54-55, November, 1934.

Wahlenberg, W. G. - "Dense Stands of Reproduction and Stunted Individual Seedlings of Longleaf Pine." Occasional Paper No. 39. December, 1934.

Wakeley, P. C. - "Collecting Southern Pine Cones for the Market." Submitted for 1935 Yearbook. June 21, 1934.

Winters, R. K. - "Cycles in Agricultural Land Use in the Mississippi Bottoms." Submitted for 1935 Yearbook. June 21, 1934.

Wyman, L. - "Plenty of Growing Space Needed for Turpentine Pines." Submitted for 1935 Yearbook. June 25, 1934.

———— - "Problems of the Naval Stores Industry." Oregon Annual Cruise. Vol. 15. 1934.

Ziegler, E. A. and Spillers, A. R. - "Financial Aspects of Growing Slash and Longleaf Pine in Appling County, Georgia." Multigraphed for limited distribution. May 1, 1934.

Radio Addresses Over Station WWL, Loyola University, New Orleans, La.

Bickford, C. A.	"A Profitable Improvement Cutting in Second-Growth Southern Pine." July 28, 1934.
Pessin, L. J.	"Mistletoe." December 29, 1934.
Snyder, T. E.	"Insurance Against Termites." September 8, 1934.
Wahlenberg, W. G.	"Forestry Work of the Civilian Conservation Corps." February 24, 1934.
Winters, Robert K.	"Progress of the Forest Survey in the South." July 14, 1934.

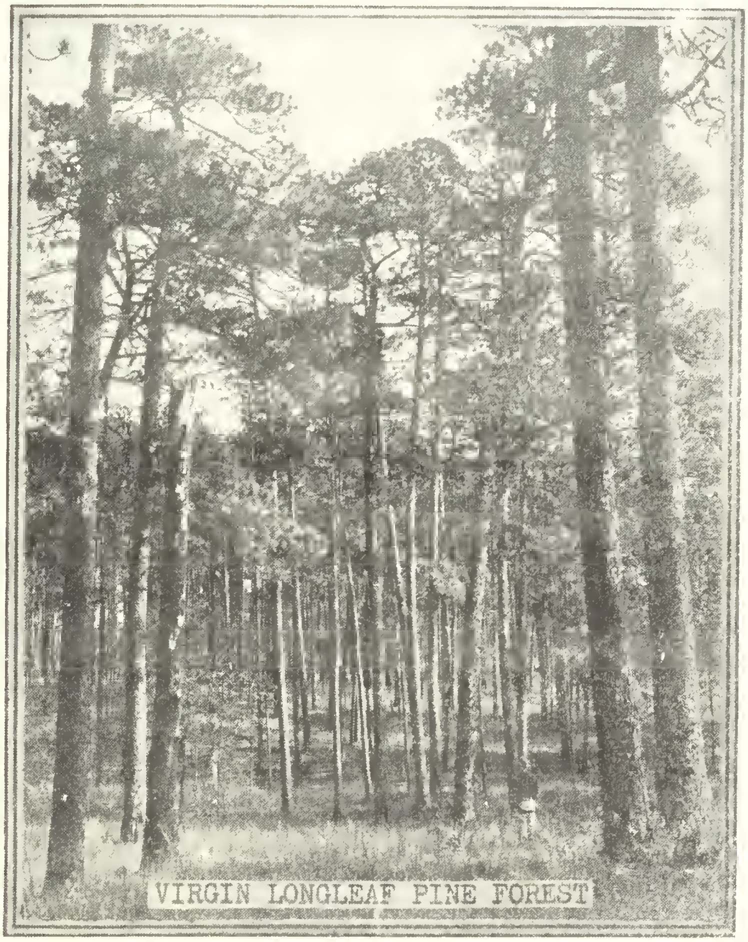
FIFTEENTH ANNUAL REPORT

OF THE

SOUTHERN FOREST EXPERIMENT STATION

E. L. Demmon, Director

New Orleans, La.


VIRGIN LONGLEAF PINE FOREST

January 1, 1935 - December 31, 1935

STAFF

SOUTHERN FOREST EXPERIMENT STATION

January 1, 1935 - December 31, 1935.

E. L. Demmon	Director
I. F. Eldredge	Principal Forest Economist
W. E. Bond	Forest Economist
Frank A. Ineson (Appointed 2/9/35)	Forest Economist
W. G. Wahlenberg	Forester
R. K. Winters	Forester
V. L. Harper	Silviculturist
Mark M. Lehrbas	Silviculturist
H. G. Meginnis	Silviculturist
Richard W. Nelson (Appointed 12/2/35)	Taxation Economist
Henry Bull	Associate Silviculturist
E. W. Gemmer	Associate Silviculturist
P. C. Wakeley	Associate Silviculturist
L. J. Pessin	Associate Forest Ecologist
R. B. Craig	Associate Forest Economist
J. W. Cruikshank	Associate Forest Economist
V. B. Davis	Associate Forest Economist
E. B. Faulks	Associate Forest Economist
J. A. Putnam	Associate Forest Economist
R. R. Reynolds	Associate Forest Economist
A. R. Spillers (Appointed 4/16/35)	Associate Forest Economist
P. R. Wheeler	Associate Forest Economist
R. E. Worthington	Associate Forest Economist
W. E. Houser	Associate Timber Expert
Roy A. Chapman	Assistant Silviculturist
F. D. Heyward	Assistant Silviculturist
T. A. Liefeld	Assistant Silviculturist
C. F. Olsen	Assistant Silviculturist
J. G. Osborne	Assistant Silviculturist
George E. Morrill	Assistant Forest Economist
C. A. Bickford	Junior Forester
Halsey M. Hicks.	Junior Forester
Morris A. Huberman	Junior Forester
T. E. Maki	Junior Forester
Harry F. Smith	Junior Forestor
Wm. S. Stover	Junior Forester
George B. Ward, Jr.	Junior Forestor
T. E. Pease	Junior Forester
John A. Lubbe	Sr. Administrative Assistant
Vera S. Lind	Senior Clerk
Marie M. Flad	Clerk-Stenographer

Clark H. Streetman	Clerk-Stenographer
Camelia M. Larsen	Clerk
Mary R. Craig	Assistant Clerk
Elizabeth Bergland	Assistant Clerk-Stenographer
Ruth Marshall	Assistant Clerk-Stenographer
Lucille P. Olsen	Junior Clerk (Statistical)
Marvel H. Gallacher (Appointed 4/20/35)	Junior Clerk-Stenographer
Mary S. Gloger (Resigned 9/14/35)	Junior Clerk-Stenographer
May M. Patchett	Junior Clerk-Stenographer
Ruth H. Angelo (Appointed 8/9/35)	Telephone Operator
William G. O'Regan (Appointed 5/15/35)	Junior Messenger

COOPERATING PERSONNEL

T. E. Snyder (Bureau of Entomology and Plant Quarantine)	Senior Entomologist
Thomas D. Burleigh (Bureau of Biological Survey) (Reported 4/15/35)	Associate Biologist
P. V. Siggers (Bureau of Plant Industry)	Associate Pathologist
Ira Hatfield (Bureau of Plant Industry)	Assistant Pathologist
Howard Lamb (Bureau of Plant Industry)	Junior Pathologist

TEMPORARY TECHNICAL STAFF

A. H. Antonie (Appointed 11/16/35)	Technician
C. C. Delavan (Services terminated 1/7/35)	Technician
T. C. Evans	Technician
Norman E. Hawes	Technician
Ralph R. Wilson (Resigned 9/23/35)	Technician
Joseph Yencso	Technician
Norman P. Worthington (Services terminated 8/15/35)	Junior Accountant
A. D. McKellar	Junior Forester
F. P. Beasley (Services terminated 7/25/35)	Assistant Technician
C. M. Debele (Services terminated 7/12/35)	Assistant Technician
A. G. Loessner, Jr. (Services terminated 7/25/35)	Assistant Technician
G. G. McCoy (Services terminated 7/18/35)	Assistant Technician
A. L. Shepard	Assistant Technician
Allan G. Watkins (Services terminated 8/7/35)	Assistant Technician
Paul Ahern (from 1/1/35 to 2/18/35)	Technical Foreman
R. M. Murray (Resigned 12/31/35)	Technical Foreman
Felix Bailey (from 8/1/35)	Squad Foreman
Alfred M. Ewing (Services terminated 7/19/35)	Squad Foreman
W. L. Keel (from 3/21/35 to 7/12/35)	Squad Foreman
Ike Rawls	Squad Foreman

TECHNICIANS ASSIGNED TO SURVEY

R. S. Andrews
C. H. Carr
C. H. Caskey*
W. P. David
John Earley
R. Y. Edmondson
A. D. Ernest
J. P. Hale, Jr.
T. P. Hursey
J. P. Johnson
M. S. Kahler
F. J. Lemieux
E. J. Mason*
W. F. Mershon
R. L. Moseley
J. R. Nevers
D. G. O'Kelley
L. E. Price

J. W. Reno*
C. O. Scott
A. G. Steedley
W. H. Thompson
J. M. Tinker
A. D. Toler
W. J. Welsh
N. M. White
R. E. Womack
W. E. Wright
L. M. Zeigler

E. R. Linn (from 8/1/35 to 12/6/35) ...... Associate Forest Economist

---

*Furloughed, transferred, or resigned during 1935.

SOUTHERN FOREST RESEARCH ADVISORY COUNCIL

L. J. Arnold, Manager, Crossett Lumber Co., Crossett, Ark.

L. Warrington Baldwin, President, Missouri Pacific Railroad Co., St. Louis, Mo.

W. H. Barnwell, Industrial Agent, Georgia Power Company, Atlanta, Ga.

Col. R. E. Benedict, Brunswick Peninsula Co., Brunswick, Ga.

Col. P. S. Bunker, State Forester, Montgomery, Ala.

Prof. H. H. Chapman, Yale University, New Haven, Conn.

L. O. Crosby, President, Goodyear Yellow Pine Lumber Co., Picayune, Miss.

Col. D. T. Cushing, General Manager, Great Southern Lumber Co., Bogalusa La.

Mark Fenton, General Industrial Agent, Illinois Central System, Chicago, Ill.

Dr. Chas. H. Herty, Director, Pulp and Paper Laboratory, Industrial Committee of Savannah, Inc., Savannah, Ga.

F. M. Joy, Manager, Land Department, Tennessee Coal, Iron and Railroad Co., Birmingham, Ala.

A. L. Kuehn, President, American Creosoting Co., Louisville, Ky.

Prof. G. D. Marckworth, Director, School of Forestry, University of Georgia, Athens, Ga.

Dr. Wilmon Newell, Director, Agricultural Experiment Station, Gainesville, Fla.

F. W. Scott, General Manager, Union Sawmill Co., Huttig, Ark.

C. C. Sheppard, General Manager, Louisiana Central Lumber Co., Clarks, La.

E. O. Siecke, Director, Texas Forest Service, College Station, Tex.

Carl F. Speh, Secretary-Manager, Pine Institute of America, Inc., Jacksonville, Fla.

T. G. Woolford, President, Retail Credit Co., Atlanta, Ga.

CONTENTS

Page

Introduction 1
Station's Progress During 1935 1
Advisory Council 2
Experimental Forests:
  Crossett 3
  Harrison 3
  Olustee 4
  Palustris 4
Natural Areas 5
Use of Emergency Funds 5
Current Investigations and Plans for 1936:
  Fire 5
    Damage 6
    Controlled Burning 7
  Management:
    Natural Reproduction and Regeneration Cuttings (Southern Pines) 8
    Intermediate Cuttings, Southern Pine:
      Thinnings 9
      Silvicultural Improvements 10
      Pruning 11
  Forestation 12
  Measurements:
    Southern Pines 14
    Bottomland Hardwoods 14
  Naval Stores 14
    Methods of Chipping 15
  Erosion-Streamflow 15
    Mississippi Studies 15
    Other Work Centers 18
  Forest Economics:
    Financial Aspects of Private Forestry 19
      I. Loblolly-Shortleaf Pine-Hardwood Forest Region 20
      II. Slash-Longleaf Pine Naval-stores Region 22
    New Public Domain 23
  Forest Survey 25
    Forest Conditions 27
    Naval Stores 28
    Pulpwood 28
  Cooperating Agencies:
    Bureau of Plant Industry:
      Forest Pathology:
        Brown-spot needle disease 29
        Nursery diseases of black locust 30
        Asiatic chestnut 30
      Forest Products Pathology 30

Page
Current Investigations and Plans for 1936 (continued):
Cooperating Agencies (continued):
Bureau of Entomology and Plant Quarantine:
Forest Tree Insects:
Bark beetles 31
Leaf-cutting ants 32
Tip moths 32
Nursery Insects:
White grubs 32
Crop insects 32
Forest Products Insects:
Ambrosia beetles 32
Cone insects 33
Termites 33
Wood Preservatives 33
Bureau of Biological Survey 33
Forest-research Needs in the Southern Bottomland Hardwood Region 34
Articles Published or Submitted for Publication 36
Radio Addresses 41

FIFTEENTH ANNUAL REPORT

OF THE

SOUTHERN FOREST EXPERIMENT STATION

January 1, 1935 - December 31, 1935

INTRODUCTION

This report summarizes the progress of forest investigations under way at the Southern Forest Experiment Station during 1935 and outlines plans for 1936. It is the fifteenth of a series of reports issued annually since the Station was established in July 1921. The Southern Station serves the 135 million acres of commercial forest land in the eight States extending from Florida and Georgia westward to eastern Texas and Oklahoma. It is carrying on research in reforestation, timber growing, protection, forest economics, and related subjects which will serve as the scientific basis for the practice of forestry and in this way assist in promoting the full use for timber growing and other purposes of this immense forest region.

The Station moved its headquarters offices in New Orleans on July 1, 1935, from the sixth floor of the Stern Building, 348 Baronne Street, where it had been located since August 1929, to the Union Building, at 837 Gravier Street, where it now occupies the entire second and fourth floors.

STATION'S PROGRESS DURING 1935

The main achievements or progress made during the calendar year 1935 may be summarized as follows:

1. - Release of United States Department of Agriculture Technical Bulletin No. 492, in November 1935, "Artificial Reforestation in the Southern Pine Region," by Philip C. Wakeley, giving the results of many years of Station work on seed, nursery, and planting studies.

2. - Completion of the forest inventory on 107 million acres by a line-plot survey, bringing the total area competed on December 31, 1935, to 186 million acres; and making immediately available some of the outstanding findings of this survey in a series of releases.

3. - Additional development in buildings and equipment, and in forest condition, of four experimental forests, one each in Arkansas, Louisiana, Mississippi, and Florida.

4. - Preliminary survey of the watershed problems of the Ouachita Mountain region of Arkansas, prior to the selection of prospective study areas, and the drafting of plans for the initiation and conduct of a comprehensive study to determine the influence of forest cover and modifying factors on soils and the water cycle in that region.

5. - Assignment of a forest biologist to the Station, effective April 15, 1935, to work on forest-biological problems. The first assignment was in the study of the relation of birds and rodents to natural reproduction of longleaf pine.

6. - Assignment of a taxation economist to the Station in December 1935 to assist the several States in working out their forest-taxation problems.

7. - A truck-logging and mill-scale study in shortleaf and loblolly pine indicated that light cuts (minimum of 500 board feet per acre) can be profitably made. These measures, as well as selective timber management, have been adopted by several operators cutting in second-growth and virgin pine.

8. - Cost-production studies in worked-out turpentined longleaf pine showed a profit for all sizes of trees when cut into pulpwood, but indicated a loss when trees below 10 inches in diameter (breast high) are used in the production of rosin barrels.

9. - Completion of a survey of land ownership, valuations, taxation, tax delinquency, and public finance in southeastern Georgia and northeastern Florida.

10. - Formulation of rules and standards to govern planting of impoverished and eroding old fields in north Mississippi.

11. - Making available current Station findings through the following multigraphed material: 15 "Occasional Papers," 6 issues of "Southern Forestry Notes," and 11 "Forest Survey Releases"; and by numerous artices in technical and trade journals.

12. - Assistance to the Regional office of the Forest Service and to various Federal and State agencies in working out their forest problems.

ADVISORY COUNCIL

The Southern Forest Research Advisory Council, comprising 21 business, professional, and scientific men appointed by the Secretary of Agriculture, acts in an advisory capacity to the Station. The Council suffered an irreparable loss in 1935 through the accidental death on August 7 of its Chairman, Henry E. Hardtner, president of the Urania (La.) Lumber Company, Ltd., and better known as the "Father of Southern Forestry."

The tenth meeting of the Advisory Council was held in the Southern Station's headquarters office in New Orleans on October 29, 1935. Six members of the Council or their representatives were present, as well as a number of guests and representatives of other Federal agencies. Dr. Charles H. Herty was chosen Chairman. The meeting was devoted primarily to a discussion of the Station's current program. Several important studies on which little or no work is in progress were also brought up for discussion.

During the year Council members have been kept currently informed of the Station's progress. A list of members of the present Council appears in the front of this report.

EXPERIMENTAL FORESTS

Crossett (Ashley County, Ark.; 1,680 acres)

The recently acquired experimental forest in the loblolly-shortleaf-hardwood type near Crossett, Ark., is being developed for research and demonstration. A field office has been built and relief workers have constructed roads and firelines. Each of the forty-two 40-acre blocks will have a graveled road along at least one side and a permanent fireline on the other sides.

Areas to be devoted to various purposes have been designated as follows: 78 acres for "natural area" check plots; 221 acres for silvicultural experiments; 115 acres for administration and small fundamental tests; 211 acres reserved for future use, an area of relatively lightly stocked forest for which the decision as to best use has been deferred; leaving 1,003 acres in one block which will be devoted to selective-logging and economic-management studies, including a planned demonstration of sustained yield.

The sawtimber stand on the entire forest when donated to the Government was estimated in September 1934 to include about 8 million feet gross scale (International log rule) or 4.8 million feet (Doyle-Scribner rule) of sawtimber, about 8,700 cords of pulpwood, and 6,600 cords of chemical wood. According to an agreement with the donor, the Crossett Lumber Company, an equivalent volume of forest products (sawlogs, pulpwood, chemical wood, poles, etc.) is to be turned over to the Crossett Company during or at the end of the coming 20-year period. It is believed that this can be done without undue depletion of the growing stock from the forestry point of view.

Harrison (Harrison County, Miss.; 5,690 acres)

The development work during 1935 has been a continuation of that begun in 1934. C.C.C. labor, supplied by the DeSoto National Forest, cleared and graded 11 miles of road, and built 6 miles of hogproof fence, all but 1 mile of which was constructed with pressure-treated creosote posts. The remainder are heart pine. A complete topographic survey was made of the Harrison Experimental Forest with the exception of section 8; permanent corners were established at the intersection of all "forty" lines, and the data plottedon a topographic map using a 5-foot contour interval.

A W.P.A. project was started the latter part of July 1935 with 20 men. These laborers constructed 8.5 miles of fireline and half a mile of fence, and handled other tasks, including help in the establishment of several investigative plots.

At McNeill, Miss., a C.C.C. side camp for 40 men was constructed in January 1935 by the Forest Service and was used in the development of that portion of the Harrison Experimental Forest. Since July 1935, 4 miles of roads have been cleared, about 1 mile of which was graded. Office and residence quarters were built in connection with the side camp and 3/4-mile of power line assures a permanent and convenient forest quarters. Twelve hundred fence posts were salvaged from the road-clearing, sprayed to prevent decay and blue stain, and will be treated by the Forest Products Laboratory at Madison, Wis., with experimental preservative materials. Later they will be used on the Forest in the regular fencing program.

Olustee (Fla.; 3,000 acres)

During 1935 no new buildings were constructed on the Olustee Experimental Forest, but considerable work was done on roads and paths and in furthering the landscaping plans on the Experimental Forest headquarters site. In cooperation with the Florida State Highway beautification project, plans were drawn up for changes in the highway entrance portal and entrance roads.

A complete building program was drawn up and a plot plan prepared for future construction work. Sketches were made and a considerable part of the detail work, as well as labor and materials estimates, was completed preparatory to submitting as a Works Progress Administration project.

A hog- and cattle-proof fence now surrounds the entire Experimental Forest. All major firelines have been cleared and plowed. Clearing and preliminary grading were completed for the entire Experimental Forest road system. Grading surveys have been made and work initiated to bring the road system up to a high standard of service so that a minimum of future maintenance and improvement will be required.

Progress was made toward obtaining commercial power at the Experimental Forest headquarters when a W.P.A. project was allotted the Naval Stores Station of the Bureau of Chemistry and Soils for the construction of a power line from Lake City.

Palustris (Rapides and Grant Parishes, La.; 4,100 acres)

1. - CLEAR CREEK TRACT Reworked about 20 miles of fireline; located and improved 5 good surface springs for drinking water; an administrative site was cleared, leveled, and landscaped at the South Tower.

2. - **DRY PRONG TRACT.** Reworked about 15 miles of fireline; located and improved 5 good springs; started work on a 20- by 40-foot structure for storage and field office.

3. - **J. K. JOHNSON TRACT.** Twelve miles of plantation firebreaks graded by W.P.A. and E.C.W.; six miles of firelines constructed, including four miles around the exterior boundaries and two miles within the experimental area.

NATURAL AREAS

Progress was made during 1935 towards formally setting aside two natural areas in Florida, the sites for which were selected in 1934. One area is on the Osceola National Forest in the flatwoods type. It contains a stand of virgin cypress and some large second-growth slash and longleaf pine. The other area is on the Ocala National Forest and contains an old stand of sand pine and about 100 acres of virgin longleaf. The first area is well along toward final approval as a natural area. The second area depends upon acquiring certain properties, some of which are now under option.

USE OF EMERGENCY FUNDS

Federal emergency relief programs during 1935 have enabled the continuance of the Station's expanded work program and a rapid development of experimental forests. Emergency funds have also been used to offset curtailments in regular appropriations. The emergency programs from which the Station obtained help in 1935 came under five classifications: Emergency Conservation Work (E.C.W.), to contribute to the work done by the Civilian Conservation Corps Camps; Federal Emergency Relief Administration (F.E.R.A.), used largely to finance office help in New Orleans; Student Emergency Relief Administration (F.E.R.A.-- student-aid program), cooperating with 16 southern colleges and universities on eight different Station research projects; Works Progress Administration (W.P.A.), used both for office help in New Orleans and for labor on several Experimental Forests; National Industrial Recovery Administration (N.I.R.A.), used for buildings on the Experimental Forests, and for office assistance.

CURRENT INVESTIGATIONS AND PLANS FOR 1936

FIRE

Fire research at the Southern Station has been confined very largely to the silvicultural aspects of fire on southern pine forests. A thorough understanding of the role of fire, not only from the damage standpoint but also from its possible benefits, particularly in the longleaf and slash pine region, is essential to the development of good forestry practices for the South. The first fire studies (plots established in 1915 at Urania, La., by the Office of Research in Washington) were concerned mostly with fire damage. These have been continued and added to while other studies include a determination of the benefits from planned or controlled fires when used as silvicultural or protection measures. No investigative work has been done by the Station on fire detection, suppression, or behavior, except in connection with controlled-burning studies--- such an overlap occurring largely in the field of fire behavior. Research might be used to help speed up improvements in fire detection and suppression, although considerable progress along these lines has been made by the private and public efforts that are now going into the protection of about 50 million acres of southern forest lands.

The Station's present fire investigations are carried on under two main headings: *damage*, which deals with (1) mortality, (2) effect on growth, and (3) effect on yield of gum for naval-stores products; and *controlled burning*, which concerns the use of fire (1) for seedbed preparation, (2) for control of the brown-spot needle disease; and its influence on (3) site factors, (4) composition of the stand, (5) hazard reduction, etc.

DAMAGE

Over 100 sample plots located in several parts of the South are under observation to obtain information on fire damage. These plots vary in size according to the purpose for which they were established; the oldest are the Roberts Plots at Urania, established in 1915; the most recent include a series of 27 semipermanent plots laid out on the 17,000-acre Cogdell, Ga., burn of April 1934, to determine the effect of a severe spring fire on young slash pine stands. In addition to sample plots, work with individual trees and laboratory studies are also being conducted.

Remeasurements made during 1935 in plantations of loblolly and slash pine at Bogalusa, La., showed that even during the fourth year following an accidental fire in 7- and 8-year-old stands, the rate of height growth of surviving trees on the burn had not yet caught up with growth of the unburned trees. Growth of loblolly was retarded more than that of slash pine by this fire, which occurred in the spring of 1932. It caused a mortality of more than 50 percent of the loblolly but less than 10 percent of the slash pine died as a result of the fire. Defoliation of all trees was of course severe, no previous fire having occurred since the time the plantations were established.

At Olustee, Fla., in a series of plots direct-seeded to longleaf in the spring of 1934, the first fire in February 1935, when the seedlings were one year old, resulted in (1) less mortality with a light fire than when a hot, severe fire was obtained under different weather conditions; (2) longleaf seedlings with buds elevated an inch or so above the surface of the soil suffered a higher mortality than the seedlings which grew in the normal flush-with-the-ground position; (3) the longeaf seedings that had seeded in naturally shortly before the fire were entirely wiped out except for a few which were not touched by the flames as the fire passed over.

In a study of the effect of fire on gum yields, several turpentined faces were burned in 1935, some in the early spring and others in the late spring. The effect on the health and vigor of the trees, as well as on their gum-yielding capacity, will be determined.

Following a controlled burn on an area unburned during the previous 3-year period, gum yields during the next turpentining season showed slight differences in favor of the burning. The trees were raked prior to the fire and care was exercised that the fire did not scorch the faces or crowns of the trees. Why there was an increase in gum yields, even though small, on the burned plot, cannot as yet be explained. Additional studies are now being made of the chemical and physical properties of the soil on the two plots and temperatures in the soil and at the turpentined faces are being taken currently.

CONTROLLED BURNING

The study of the influence of fire on site was continued. Whether the effect is harmful, beneficial, or negligible will have a bearing on policies regarding the controlled use of fire. A few of the results of our studies to date will be given here.

Soils to a depth of 3 inches from unburned areas were found to be much more penetrable and porous and also much lighter in weight per unit volume than corresponding soils from frequently burned areas. An indication that sandy soils protected from fire have a higher content of organic matter than soils from burned areas is shown in data for hygroscopic coefficient and wilting percent, these figures being higher for the soils protected from fire. No such differences were obtained for heavier textured soils.

Indications favoring soils of burned areas were obtained for several chemical properties. These soils contained a higher percentage of: (1) total nitrogen; (2) replaceable calcium, and probably other ash constituents; and (3) were slightly but consistently less acid than soils protected from fire.

Although the study is not completed, it seems fairly safe to predict that light surface fires have no severe detrimental effect on soils of the Coastal Plain. Neither is it likely that these forest soils are materially benefited by fire. That frequent fires do not materially influence organic matter below the top 1/4-inch of mineral soil may be attributed to the fact that beneath this depth the soil is rarely heated to a point where organic matter is burned. This fact was checked by measurements of soil temperatures made during 30 fires.

Studies of controlled burning were conducted in southern Georgia and on permanent fire plots on the Olustee Experimental Forest. Considerable attention was given to the proper technic of burning. Studies to date indicate the desirability of thinning dense slash pine stands immediately before the burning is done, and for ordinary flatwoods stands it seems best to burn against the wind if moderate to heavy defoliation is to be avoided. The choice of burning with or against the wind will depend on a comparison of the cost of the controlled burning against a certain amount of defoliation, which is known to have a retarding effect on growth. Additional experience and study should result in developing a cheaper and better technic than that now in use.

A study of the effects of controlled burning on growth in thinned stands of slash pine 6 to 8 years old was initiated in 1935 on 12 permanent sample plots near Cogdell, Ga.

MANAGEMENT

NATURAL REPRODUCTION AND REGENERATION CUTTINGS
(SOUTHERN PINES)

Forest regeneration involves the reestablishment of forests by means of self-sown seed or sprouts. The ramifications of the Station's studies under this project are extremely varied. They include primarily studies in silvics and forest ecology, but the fields of forest entomology, pathology, wildlife, and influence of fire are also involved. Coordination among these various projects is essential. The major emphasis in the Station's natural-reproduction studies is along the following lines:

1. Recognition and control of site factors which have a direct influence upon natural regeneration of the southern pines. These involve fundamental studies of the water and nutrient requirements of seedlings, the effect of surface-soil conditions on germination, and the factors influencing early survival and establishment.

2. Obtaining an adequate seed supply through increase in seed production and by taking protective measures against destructive agents. Included are studies of meteorological factors, fundamentals of seed production, and the food habits of animals and birds which consume forest-tree seed.

3. Early and successful regeneration of desirable tree species by altering stand and site conditions. Silvicultural methods of cutting, mechanical preparation of the seedbed, and the silvicultural use of fire to assist the establishment of new timber stands are included under this heading.

In 1934 it was evident that one of the infrequent heavy seed crops for longeaf pine would probably materialize in the fall of 1935. Efforts were therefore concentrated on taking advantage of this crop by the initiation of additional field work to study the establishment of longleaf seedlings.

A preliminary study of the water requirements of both longleaf and slash pine seedlings was completed during 1935. In connection with a study of the factors influencing the establishment of longleaf pine, a fairly complete inventory of the birds and mammals on the Harrison Experimental Forest in southern Mississippi was made by the forest biologist.

At Lake City, Fla., the seedbed-preparation study conducted in 1934 was repeated. It was found that exposed mineral surface soil, soil broken up but with vegetation left on top, and a freshly burned-over soil were about equally effective in obtaining good germination and establishment of longleaf and slash pines. For longleaf, germinaton was 3 to 4 times better and with slash pine 2 to 3 times better under the above conditions than where a heavy ground cover of grass that had not been burned off in the previous 3 or 4 years was left undisturbed. Burning off of the grass cover 1 year prior to seed fall was intermediate in effectiveness between areas where several years' accumulation of grass was present and where the soil was completely exposed. The results of the 1935 test substantiated and strengthened the conclusions reached in the 1934 study. Additional seedbed studies, both intensive and extensive, have been begun on the Harrison and Palustris Experimental Forests in Mississippi and Louisiana.

Increased laboratory facilities have allowed certain studies to parallel field investigations, which will help explain the results obtained from the field plots.

The 1936 program is planned to provide:

1. Continuation of work now under way, supplemented by further studies in soil and site preparation.

2. Further work on the fundamentals of water and nutrient requirements of pine seedlings.

3. Silvicultural studies of various methods of cutting in mixed loblolly-hardwood stands as a complement to the selective-logging studies under way at Crossett, Ark. Similar cutting methods should be studied in the longleaf-slash pine country. The problem of methods of cutting has become particularly important where pine stands are being heavily cut for pulpwood in various parts of the South, especially in the southeast Gulf section.

INTERMEDIATE CUTTINGS, SOUTHERN PINE

Thinnings

Two new thinning plots were established in February and March 1935 in the Mayes old-field shortleaf pine stand near Urania, La. Their purpose is to determine---from the standpoints of financial returns, growth of residual trees, and reproduction of a new stand---the results of very heavy crown thinnings in a 42-year-old old-field stand of loblolly and shortleaf pines on a poor site. Three plots had previously been established in this same old-field stand, in 1915; two plots were thinned from below (light and heavy) and one plot was left unthinned as a check. Despite these 1915 thinnings, and several more made during the 1915-35 period, the trees remaining on these long-established plots show very poor growth, although up to 1915 when the trees were 22 years old their growth had been fair to good. At the present rate of growth it will take another 40 years for the dominant trees to reach sawlog size (17 inches d.b.h.). It seemed worthwhile, therefore, to try out a radically different treatment: Harvesting the major portion of the slow-growing stand at once for pulpwood, leaving only the very best and most vigorous trees for a later cut of sawlogs, and trying to secure vigorous reproduction in the openings thus created. It may well be that two good crops of pulpwood and one fair crop of high-quality sawlogs can be grown on this type of land in the same time required to grow one good crop of sawlogs, and at a greater financial profit. Stands similar to those found on these plots are, and will continue to be, common in the South. This consideration and the probability of increasing pulpwood markets make these new experiments with heavy thinnings valuable and timely.

During 1936 it is planned to make an intensive study, using temporary plots, of the degree of thinning needed at various ages to produce and maintain different average rates of growth in second-growth slash pine. The problems of when and how much to thin in dense second-growth stands of slash pine in the Southeast are becoming increasingly important. The proposed study offers the advantage of obtaining the information within a relatively short time instead of relying solely on permanent sample plots which yield such information only after a large number of plots have been established, and have been remeasured over a long period of years.

Silvicultural Improvements

The girdling and poisoning stand-improvement experiment initiated on the Ouachita National Forest, Ark., in 1929 and reexamined for the last time in 1934 was worked up in detail and a comprehensive office report prepared. The results of this study taken in conjunction with the results (to 1935) of girdling and felling experiments at Urania, La.; on the Palustris Experimental Forest, near Alexandria, La.; and on a number of National and State Forests in the South, were used in preparing a comprehensive paper, "Killing Undesirable Hardwoods in Southern Forests." This was issued as Occasional Paper No. 50 in September 1935. The conclusions were as follows:

1. Felling by cutting close to the ground, and partial felling and bending over, are the best methods for killing or removing the crown competition of small hardwoods, up to 3 to 5 inches in diameter at breast height. Because of the sprouting that will usually occur, neither method is advisable if there are no pines or more valuable hardwoods to be released, or if these more valuable trees are less than about 5 feet high.

   An important exception occurs in the longleaf-scrub oak type where longleaf pine less than about 4 or 5 feet high is overtopped by relatively small scrub oaks. Omission of treatment in such stands may result in the death of a large proportion of the longleaf seedlings. In view of the relatively long interval between good longleaf seed years, and the usual delay that precedes any appreciable height growth of longleaf seedlings, the probable high mortality in natural stands is considered a sufficient reason for stand improvement. However, the only method likely to be successful in permanently releasing small longleaf pines from scrub oaks involves at least one and usually several follow-up treatments---cutting the oaks close to the ground and returning often enough to cut back the oak sprouts when they reach the height of the pines.

2. Girdling is the best method for killing larger hardwoods. A "double-hack" or "chip" girdle, exposing about a 4-inch band of sapwood, offers the best combination of effectiveness and cheapness, with ordinary labor and for all hardwood species. If, however, the workmen are unusually experienced and conscientious, "single-hacking" or "frilling", with the edges of the cuts separated by twisting the ax, is likely to be satisfactory and is somewhat cheaper.

3. Poisoning is usually unnecessarily expensive and cannot be justified by any outstanding or consistent advantages.

These statements are applicable to average stand-improvement operations in the South, and the word "best" merely implies that the advantages outweigh the disadvantages for conditions. The various methods are discussed in detail in the paper mentioned above.

Numerous small-scale and several large-scale stand-improvement experiments are planned for 1936 on the Palustris Experimental Forest, with the objects of determining (1) a cheap and effective treatment that will prevent the sprouting of small hardwoods killed in stand-improvement work, where such sprouting is undesirable; and (2) the actual benefit, in terms of increased growth and decreased mortality of desirable trees, from different methods and intensities of treatment.

Pruning

Pruning limby young pines to increase their quality for future sawlogs is an intensive method of stand improvement that has received little attention in the South to date. It may, however, prove to be a very profitable measure when conducted on a large scale and under favorable circumstances. In February 1935 at Urania, La., the Station established its second pruning experiment. The study was designed to compare the suitability of various commercial pruning and cutting tools with respect to the speed of the operation and to the quality of the work. Eleven hand tools and two pole saws were used, and 423 second-growth pines, mostly loblolly, from 3 to 8 inches in d.b.h., were pruned up to 17 feet (for a full 16-foot log above a 1-foot stump).

Impact tools, such as axes and bolo knives, were found to give the most speed but were relatively unsafe to use and the quality of the work was considerably lower than with saws. Of the hand saws used, the most satisfactory models were curved pruning saws, with open, pistol-grip handles and fairly stiff blades, about 14 inches long and with 5-1/2 to 8 teeth per inch. The section of the tree between 8 and 17 feet from the ground was pruned with hand saws from ladders, or with long-handled pole saws from the ground. The pole saws were found to be faster and the quality of work equal to that done with hand saws used from ladders. The better of the two pole saws had the longer, heavier, and stiffer blade---curved, about 16 inches long, 7 teeth per inch, and cutting only on the pull or draw stroke.

Loblolly pine is rather easy to prune with a pole saw, as the limbs are not heavily concentrated in definite whorls and, for the most part, can be readily singled out and sawed from a position at right angles to their length without getting the saw stuck in a cluster of small and large limbs originating nearby. Loblolly limbs also show no tendency to strip off bark from the main stem just below their origin, when they break before having been cut entirely through.

The time required for pruning was found to vary widely, according to such factors as (1) height of pruning, (2) species, (3) tool or method, (4) diameter of tree, (5) skill of workman, and (6) number and average size of branches. To give a general idea of the cost of pruning, it may be stated that the average time actually required to prune 5-inch loblolly pines up to 17 feet was equivalent to 11 man-hours per 100 trees. This is based on average total elapsed working time (directly effective time plus moving time plus idle time) for 4 men using 13 different tools, in a well-stocked stand in which the dominant trees ranged from 5 to 8 inches in diameter at breast height.

It is planned to make detailed studies of pruning of open-grown second-growth longleaf pine on the Palustris and Harrison Experimental Forests during 1936.

FORESTATION

The Station's forestation project involves two main problems: (1) to improve the quality of artificially regenerated forest stands, and (2) to decrease the cost of establishing them. Their solution will provide a reliable, economical method of reforesting land which is unable to renew itself naturally and which otherwise might remain idle.

The Station's forestation work began with collection of seed on a small scale in 1921, and the establishment of an experimental nursery at McNeill, Miss., in 1922. Comprehensive seed studies, beginning with germination tests, were undertaken in 1924, and have continued ever since. Nurseries were maintained either at McNeill or at Bogalusa, La., from 1922 through 1928, inclusive; a nursery for the study of exotic species and of problems peculiar to the deep sands of western Florida was established at Camp Pinchot, Fla., in 1927.

Experimental plantations were established at Urania, La., McNeill, Miss., Bogalusa, La., and Camp Pinchot, Fla., at various times beginning in 1923; of these, the most important were those established at Bogalusa in 1923, 1925, 1926, and 1927, totaling 25 acres. Studies have been made of commercial plantations and of nearly two dozen Federal, State, and private nurseries; the Station has also availed itself of the services of several cooperating universities and other agencies in studying the germination, extraction, storage, and production of tree seed.

The phases of the forestation work just described have dealt particularly with the four principal southern pines. The Station's particular contributions in connection with seed include data on seed production, weight and yield figures, methods of testing germination, kiln extraction, and storage of southern pine seed. Its nursery studies have helped determine optimum density and depth of sowing, have led to the general abandonment of shading of seedbeds, have tested the possibilities of chemical weeding, and have established standards for different grades of pine nursery stock and shown their importance in terms of survival and growth in the field. Its planting experiments have contributed to the knowledge of survival, growth, development, and injuries of plantations; the effects of spacing; and the suitability of species for site, and of exotic species for the climate of the Gulf States. There have also been minor contributions bearing upon site preparation, planting tools, planting seasons, and direct seeding.

These contributions, combined with general observations and records of other work, have been compiled into a forestation manual, which was published in November 1935 as United States Department of Agriculture Technical Bulletin No. 492, "Artificial Reforestation in the Southern Pine Region" (115 pp., illus.).

In 1934, the staff assigned to forestation studies was increased from 1 to 3 men; nursery, office, and laboratory quarters were established; new studies were laid out at the United States Forest Service nursery near Alexandria, La.; and a 1,200-acre tract (part of the Palustris Experimental Forest on the Kisatchie National Forest) was prepared for experimental planting. Preliminary studies of soil quality, normal life history, percentage of good seed developing into plantable trees, cultural methods (spacing, shading, root-pruning in place, etc.), and chemical weeding were made, and a 10-year program for research in forestation, especially designed to fill gaps in existing knowledge, was worked out and adopted.

During 1935 the Station completed a detailed estimate of the cone crop of the four principal southern pines, based on local reports of 134 cooperators covering 370 different areas. Small plantations were established to compare the development of slash pine seedlings from seed from two different sources, and longleaf pine from seed from four sources. Nursery studies were expanded, and covered normal life history, percentages of seed producing plantable stock, cultural studies, weeding studies (including life history of weeds), and fertilizer studies, especially long-time nursery soil management and maintenance by the use of legumes. On the new experimental planting area already described, 483 experimental plantations were established, covering 269 acres, and approximately 350,000 seedlings were used. The greatest area (213 acres) was used in replicated series to test the effects of spacing and later of thinning, both without use of fire and with controlled burning, upon the development of longleaf and slash pine. Approximately 20 acres were devoted to replicated plots to test the effect upon first-year survival of longleaf and slash pine of topographic site, preparation of site, tool used, care in planting, weather, storage of planting stock, and exposure of roots to sun and wind at time of lifting. Two survival counts were made in 1935 (June and October) of the 33,900 trees in these plots. Other studies included effect of grades, mixture of species, and underplanting of brush.

In addition to the planting work on the Palustris Experimental Forest, the 10-year remeasurement was made on 12 acres of plantions at Bogalusa.

Present plans are to integrate the type of forestation studies already carried on with the seed, nursery, and planting phases of erosion-control work, and with certain phases of physiological and soils work now included under natural-regeneration studies. Work planned in forestation for 1936 includes a comprehensive study of effect of seed source of the four principal species of southern pine, an extension of seed testing to include new methods and species not yet studied, and a detailed study of the physics of seed extraction, including internal temperatures of cones in the kiln as determined by means of thermocouples. Projected nursery studies include a continuation of the 1935 studies, with special emphasis on the problem of percentage of sound seed developing into plantable trees. Under current practice this percentage is far too low, rarely as much as 40 percent; most of the loss occurs in the brief period between sowing and the removal of the mulch, and special efforts will be made to find and control the causes of this loss. Projected planting studies will deal primarily with causes of low survival, direct seeding, plantations of mixed stands, conversion of brush stands to pine, and site preference of species. Work will also be continued on a directory of pine plantations throughout the South.

MEASUREMENTS

Southern Pines

Complete stem measurements of 132 loblolly and 50 shortleaf pines ranging from 4.6 to 13.0 inches in diameter at breast height were obtained on 9 thinning and methods-of-cutting plots at Urania in 1934-35. During 1935 these measurements were plotted on special forms (Form 558a) and the corresponding individual tree volumes were obtained. These data are being combined with similar volume-table data obtained at Urania in studies of volume-table technic, the relation of volume to crown class, and the applicability of present volume tables.

The *Financial Aspects of Private Forestry* and *Forest Survey* projects are carrying on considerable work on measurements and on growth and yield of southern pines as fundamental and essential to the projects. This is reported under the specific projects concerned.

During 1936 it is planned to establish a large number of mechanically spaced permanent growth plots on each of the Station's Experimental Forests except at Crossett, where such plots have already been established. These plots will be remeasured at 5-year intervals and will provide data on the actual growth, yield, and mortality of stands of various types, conditions, sites, and densities. Information of this kind from permanent sample plots is essential to the development of the best forest-management practices.

Bottomland Hardwoods

An Occasional Paper (No. 54) was published December 4, 1935, entitled "Growth and Yield of Second-growth Red Gum in Fully Stocked Stands on Alluvial Lands in the South."

NAVAL STORES

Whether or not improved turpentining practices are adopted will determine in large part the success or failure of many naval-stores operations in the future. Successful turpentine operators should have a working knowledge of the factors affecting gum yields and tree growth, which vary with the character of timber, site, time of working, and methods used. Considerable data on growth and gum yields have already been gathered by the Station and recommendations have been set forth currently. Definite progress was made during 1935 along the following lines:

Methods of Chipping

At Stockton, Ga., the first year of turpentining was completed on a test of height and depth of chipping on vigorous, fast-growing slash pines. The results showed a consistent gain in yield with increase in depth of streak from 1/4-inch to 1 inch, each additional 1/4-inch in depth producing about 8 percent more gum. The 1-inch-deep chipping produced about 24 percent more gum than the 1/4-inch-deep chipping, and 3/4-inch depth 16 percent more. There is no indication thus far that chipping 3/4-inch to 1 inch deep is too severe for trees ranging in growth rate from 1 to 10 rings per last 1/2-inch of radius, but it is recognized that ill effects such as dry-facing would probably not show up the first year of working. The same study indicated that 1/4-inch-height streaks produce about 10 percent less gum than those 1/2-inch in height; 3/4-inch-height streaks showed very little difference in yield from the 1/2-inch. It is planned to continue this experiment for several years.

An experiment was initiated on the Osceola National Forest to determine the economic feasibility of turpentining bark bars (live wood remaining between turpentine faces) on trees that are usually considered as worked out or useless for further turpentining. The purpose of this study is to determine the minimum size of bark bar that can be worked profitably, and the optimum size of turpentine face to install on bark bars of varying widths.

The minimum size at which trees should first be faced, the optimum width of face to use, and the best working schedule for first, second, and perhaps third or later faces require a knowledge of the yields to be expected during different years of work, and also rate of growth and rate of healing of the old turpentine faces. Field work on a rate-of-healing test was initiated during 1935.

An experiment to determine the effect on turpentine content of longleaf pine gum of tree diameter, growth rate, yielding capacity, height of the face above the cup, and the frequency of dipping cups was started in cooperation with the Naval Stores Station of the Bureau of Chemistry and soils at Olustee, Fla.

EROSION-STREAMFLOW

Investigations under the forest-influences project were started by the Station in 1929 and have thus far been limited to a single region---the Loessial Uplands in the State of Mississippi. Since 1930 these studies have been concentrated in the vicinity of Holly Springs, Marshall County, in the extreme northern part of the State. During 1935, extensive surveys were made in other parts of the Station's territory preliminary to the initiation of additional work in localities where such investigation seem most needed.

MISSISSIPPI STUDIES

In the Mississippi Loessial Region the wasteful exploitation of upland soils cleared for agriculture has given rise to a land-use problem of major importance. Improper cultural practices which permit uncontrolled surface washing of sloping lands by rainfall have transformed hundreds of thousands of acres of what was once fertile agricultural land into eroding wastes, the productive capacity of which has been greatly impaired, if not ruined. The reforestation of this vast domain of abandoned agricultural lands appears to be the most feasible means of restoring it to productivity. A major obstacle, however, is lack of information on low-cost, effective methods of bringing this about.

The Station's Mississippi studies are designed to provide answers to two broad questions relating to the use and management of such lands: (1) how can eroding abandoned lands be rehabilitated through inexpensive forest-restoration measures?; and (2) what effect will these measures have on soils, ground-water supplies, and stream behavior? In lowland portions of this region destructive floods are frequent and constitute a serious menace to property. The extent to which forests exert a beneficial influence on streamflow and are effective as a supplemental agency in the control of floods is being investigated under this project.

Up to 1935 the Station's erosion-streamflow studies have been conducted on privately owned land and on areas provided by the Mississippi Agricultural Experiment Station. During 1935 certain areas on the newly acquired National Forest near Holly Springs were set aside for research use.

Studies designed to supply answers to question number 1 above have been carried on from 1931 to date. These studies may be termed revegetation or land-reclamation studies and include investigations under three headings: (1) comparative tests of tree and plant species suitable for this purpose; (2) studies dealing with methods of establishing the most promising plant species; and (3) general methods of controlling and reclaiming gullies. Large-scale plantings have not been attempted and the plantations established to date have been confined to a number of small areas which are kept under detailed observation. During the period 1931 to 1934, approximately 20 acres were planted to about 29,000 trees, including some 20 species of hardwoods and conifers. Various herbaceous plants were also employed separately and in combination with the tree plantings.

In 1935, 41 acres were planted, using 47,500 trees of 7 species, chiefly black locust and shortleaf pine. Of these, 36,038 were planted on one of the Station's experimental areas, using C.C.C. labor. The remaining trees were planted by the Administrative Branch on a 13-acre tract where the Station planned and applied various experimental treatments involving site preparation, use of surface mulches, and several grades of planting stock.

Over 20 studies are represented in the 1935 plantings. Only a few species tests were made and most of the studies initiated in 1935 were establishment tests with black locust and shortleaf, including seasonal studies, methods of planting, use of mulches, planting stock and grades, progeny tests, and special treatments. Additional studies dealing with general methods of gully control were also begun.

Preliminary observations of some of the 1935 plantings indicate that: (1) black locust on sterile sites shows marked growth response from the application of a small quantity of stable manure as a surface mulch around each tree; (2) slant or oblique planting of locust and shortleaf (planting the tree at a 45-degree angle from the horizontal) increases the planting speed by 50 percent over the usual vertical planting and, with black locust, produces within a few weeks upright trees averaging about the same in growth and survival as those planted in the orthodox manner; (3) black locust nursery seedlings planted in the field in November while in full foliage show as favorable growth and survival as those planted a little later during the dormant period; (4) very severe root-pruning of black locust prior to planting has very little effect on field survival and initial growth; and (5) if losses of locust planting stock through root decay are to be avoided, stock should not be stored in nursery clay loam, even for short periods, after lifting, unless soil moisture remains well below field moisture-holding capacity or unless the roots are thoroughly washed following such temporary storage treatment.

The results gained from these land-reclamation studies have served as a guide for large-scale erosion-control projects which State and Federal agencies have been carrying on in north Mississippi during the past 2 years as a part of the E.C.W. program. Additional studies of the above type are planned for 1936 and succeeding years with special emphasis on the plant-establishment methods which give the most promise of supplanting the relatively expensive site-preparatory measures still in use on many erosion-control projects. The general objective is to develop measures for successfully establishing tree and plant cover on denuded, eroding land---information which will serve as a basis for formulating sound erosion-control programs in this region.

Supplementing the planting studies are nursery investigations carried on for the past 3 years at Holly Springs, Miss. In these investigations some of the factors affecting seedling yields are being studied. A sulphuric acid seed treatment for black locust, resulting from these studies, was found to greatly increase the yield of plantable seedlings and has already proved its worth in large-scale operations. In 1935 more than 4 tons of black locust seed were treated by this method for use in north Mississippi nurseries. The Station's 1935 nursery studies dealt specificially with the effect of depth of covering and rates of sowing on seedling yields, but owing to drought and other unfavorable conditions, the results from these will probably be inconclusive.

The second broad group of studies deals with the influence of the forest on soils and the water cycle; in particular, the effects of restoring a plant cover to barren eroding areas will be determined.

In a 2-year study of soil and water losses from 7 types of cover and land use, using small run-off plots, it was found that soils protected by a forest or grass cover are capable of absorbing practically all of the rainfall and lose but negligible quantities of soil. In June 1935 the results of this study were published as United States Department of Agriculture Circular No. 347, entitled "Effect of Cover on Surface Run-off and Erosion in the Loessial Uplands of Mississippi." The small plot studies have been discontinued excepting a pair of plots used in a forest-litter study and two sets of paired plots, one forested and the other in grass cover, where the effects of annual winter grass fires on water absorption and soil erosion are being tested. Some of the preliminary results from these studies have been reported in previous annual reports of the Station.

In another study, in progress since 1932, the stormflow from 2 small actively eroding watersheds of less than an acre each was measured before and after the application of vegetative control measures. During a preliminary period of 3 years, stormflow data were obtained for individual rains while the areas were in their original barren condition. Early in 1935 control measures were inaugurated. Simple brush check dams were constructed along the drainage lines, the areas were plowed, seed of common lespedeza was broadcast and covered lightly with litter, small pieces of Bermuda grass sod were scattered and tamped in place, and lastly black locust seedlings were planted. An excellent and fairly complete plant cover has resulted and, although no exact figures are as yet available, it is very evident that soil losses have been greatly reduced as a result of the control measures. Indications also point to a reduction in stormflow rates during the few months since the areas were revegetated.

There is a distinct need for similar information from large-scale erosion-control areas. Although the healing of gullies, with an accompanying reduction in surface run-off and erosion, is a rather self-evident process, it is important to have specific data on these points. A yardstick is needed to measure the effectiveness of control measures carried out or planned on thousands of acres of waste land in this region, particularly since these measures are believed to have an important bearing on controlling and ameliorating floods. Large-scale studies supplying such information are planned for 1936, contingent on available finances. They would involve studies similar to those mentioned above, and would make use of gully watersheds up to 10 acres in size.

Additional run-off studies are also needed to evaluate forest and flood relationships. One such study would measure water losses from small forested watersheds 5 to 10 acres in area, to verify, on actual topographic drainage units, data obtained from the previously mentioned small plot studies. Supplementing this would be a study of rainfall penetration and retention on typical soil profiles, to determine whether soils of this region are capable of either retaining large quantities of rainfall or disposing of it through deep infiltration; in other words, whether soils protected by a plant cover would effectively dispose of water so that it would not augment flood volumes. In another study relating to the influence of forest cover on ground-water yields, the flow of living springs would be measured prior to and after altering cover conditions by several treatments.

OTHER WORK CENTERS

During 1935, extensive surveys were made in certain portions of the Station's territory to observe watershed conditions and to determine what watershed problems are most in need of investigation. These surveys covered portions of the Piedmont, Mountain, and Coastal Plain sections of Georgia, Alabama, and Mississippi. In the Ouachita highlands of Arkansas, more detailed observations were made of the factors affecting stream behavior, including cover types, geologic factors, fire, timber-utilization practices, and human activities.

The major watershed problems of the Ouachita region were found to originate from (1) an erratic flow of streams manifested by damaging floods and poorly maintained flow, (2) prevalence of thin, unproductive soils, and (3) excessive surface washing and wastage on agricultural soils. This survey indicated that of the factors conceivably affecting forested mountain watersheds, fire and timber-utilization practices need study.

Following the Ouachita region survey, preliminary plans were developed for the initiation and conduct of a comprehensive watershed study in this region to determine the influence of forest cover on soils and stream behavior, and to furnish answers to the following questions: (1) To what extent and in what manner do timber-utilization practices affect watershed values? (2) How do fires affect soil and water resources and how essential is intensive fire protection in relation to the maintenance of watershed values?

Several prospective experimental-forest areas on the Ouachita National Forest have been tentatively selected for an intensive watershed study to be started when funds become available. Such a study would include observations during a preliminary period of several years on relatively small watershed units composing one or more headwater drainage systems, data being taken on plant cover, climate, ground water, and streamflow. The forest and plant cover would then be altered, the treatment conforming to forest-management and utilization practices. Investigations would include (1) an accurate survey and cover-type inventory, (2) measurement of rainfall and related climatic factors, (3) measurement of streamflow, and (4) the collection of data from a number of supplemental ground-water studies employing small run-off plots, small topographic drainage units, run-off percolation plots, soil sampling pits, and test wells.

FOREST ECONOMICS

FINANCIAL ASPECTS OF PRIVATE FORESTRY

During 1935 the Financial Aspects project continued investigations on income, costs, and most profitable methods for sustained-yield management of southern forests. Some of the large forest-land owners in the South are putting their properties under sustained-yield management and many others are becoming interested in doing so. Before changing over to this new method of managing their properties, forest owners need to determine: (1) the volume and value of stumpage that can be cut, or of finished forest products that can be manufactured annually, without reducing the growth capacity of their forests; (2) costs and methods of timber management, including timber inventory, growth and yield determinations, marking, protection, and taxes; (3) costs and methods of cutting designated trees and transporting raw forest products to the manufacturing plant; (4) costs and methods of manufacturing into finished forest products; (5) net returns from sustained-yield forest management.

In order to make the most out of its limited funds, the Station's efforts were concentrated on the Crossett Experimental Forest and surrounding forest land near Crossett, Ark., which is representative of a large part of the loblolly-shortleaf pine-hardwood region west of the Mississippi River; and in southern Georgia and northern Florida, which is typical of the longleaf-slash pine naval-stores region. In these two forest regions, forest and economic conditions are generally favorable for profitable sustained-yield forest management.

The following economics studies are now under way in these two forest regions:

I. Loblolly-Shortleaf Pine-Hardwood Forest Region

1. *Selective timber management in second-growth loblolly and shortleaf pine.* Second-growth stands in the loblolly-shortleaf pine-hardwood region have generally developed following the logging of the original-growth timber, and present stands are commonly made up of trees of many sizes. In order to log these stands so as to provide for successive future cuts, it is necessary to remove trees that are financially mature, and also at the same time take out trees which, because of crook or defect, will not pay to be left for further growth. This kind of a cut in such stands usually removes only a small volume of the merchantable material present. Truck logging rather than railroad logging is generally necessary if such operations are to be profitable.

To determine whether the removal of small volumes per acre is feasible, a selective-logging study was started in a second-growth loblolly-shortleaf pine stand averaging about 5,000 feet per acre and various volumes ranging from a minimum of 500 board feet to a maximum of 4,000 board feet per acre were removed. An accurate record was kept of all costs. A preliminary analysis of the data indicates that as little as 500 board feet per acre can be removed from such second-growth stands at a profit. The actual cost of truck logging, with an average haul of 5 miles (but not including an allowance for profit to the contractor) amounted to about $3 per thousand feet log scale during dry weather. The cost was only slightly increased when the smaller volumes per acre were removed. During wet weather logging costs increased by about 50 percent and during periods of heavy rains logging was impossible. Provision for keeping the mill supplied with logs during wet periods can be made by banking a supply of logs just ahead of the normal wet season or by logging only near gravel roads during wet weather. The damage to the residual stand as a result of selective logging in second-growth stands was very slight, probably not over 2 percent.

When the logs from the selectively cut areas were cut into lumber at the mill, it was found that the smaller pine logs, especially top logs, failed to produce lumber of sufficient value to equal the costs of logging and manufacturing. However, when cut into pulpwood these logs were found to pay their way. A surprisingly large percentage of the hardwood logs were also logged and manufactured at a loss. This was because of the large amount of crook and defect present. The value of lumber cut from pine logs ranged from $20 per thousand feet for grade 4 logs to $30 for grade 1 logs. Where pulpwood was cut from the tops and from defective trees, after allowing 50 cents for stumpage and the necessary costs for hauling, cutters could earn about $1.50 per 8-hour day.

The results of the Station's economics studies have been made available to many timberland owners in this region. One large lumber company has worked out the increment and the allowable cut for its second-growth pine stands and is marking all timber before cutting, based on a 100 percent inventory of trees 12 inches and over in diameter, for both trees to be cut and those to be left. This company has found that selective timber management can be practiced at a profit and that it will provide, by leaving a residual stand of high-grade, fast-growing timber, for future cuts at 10-year intervals.

During 1936 a similar study, using tractors instead of trucks, is planned.

2. *Selective timber management in virgin loblolly and shortleaf pine stands.* As the result of a Station study of allowable cut based on growth in virgin loblolly-shortleaf pine, a large company adopted the system of selective timber management for its remaining virgin timber stands. The tract is being logged by railroad during the winter months when truck logging is impossible. By cutting to a flexible 24-inch diameter limit, and removing about 50 percent of the saw-timber volume, costs of logging are slightly more than when cutting to a 14-inch d.b.h. limit, as was the previous practice. Costs are very little more because fewer spurs are necessary where more of a stand is left uncut and also because the average log is of considerably larger size than when cutting to a 14-inch diameter limit.

In the sawmill the cost of manufacturing logs of the larger average size obtained under selective logging is considerably less than cutting to lower diameter limits. However, the percentage of B & B grade of lumber was slightly less from selectively cut virgin timber stands. This is due to the preponderance of overmature and defective trees, as many of the rapidly growing highest-grade trees were reserved for future cuts, to be made at 10-year intervals. By cutting selectively it will be possible to produce high-grade materials in the future which would not be possible if these cuts were to come entirely from second-growth stands.

During 1936 the feasibility of logging with wide-tread tractors during both wet and dry seasons will be studied.

3. *Sustained-yield management of second-growth loblolly and shortleaf pine.* Many lumbermen and other forest-land owners in the loblolly-shortleaf pine region are interested in the possibilities of sustained-yield management, but are confused as to the exact methods to follow and the financial possibilities of such a venture. In order to determine these facts, approximately 1,000 acres of second-growth loblolly and shortleaf pine on the Crossett Experimental Forest near Crossett, Ark., have been set aside for intensive demonstration and study. An inventory and growth study on this area was made in 1934.

On this 1,000 acres the stand averages 5,000 feet per acre (International rule), varying on different 40-acre blocks from 3,000 to 9,000 feet per acre. The total volume is estimated at 5,290,000 feet board measure, of which about one fifth is in hardwoods. Of the merchantable pine volume, 29 percent is in trees 17 inches d.b.h. or larger and 69 percent of the hardwood volume is in trees over 17 inches in diameter, thus providing the basis for an initial cutting in the near future. The site is of good quality for growth of pine timber, loblolly pines reaching 75 to 85 feet in height in 50 years. Diameter growth has slowed down somewhat in the last 10 years, but is satisfactory. The 4- to 9-inch trees are growing at a rate requiring about 5 years to increase 1 inch in diameter, the 10- to 14-inch trees are growing somewhat faster, and above 14 inches only about 4 years are required to increase 1 inch in diameter.

With this as a basis, practical methods of determining growth and allowable cut will be developed to guide forest-land owners for similar work on their own lands. Careful records will be kept of all costs and returns from operations on this experimental forest. In a few years the experimental forest should serve as a practical demonstration of sustained-yield management, and a record of costs and returns will be available to anyone who wishes to look into them.

II. Slash-Longleaf Pine Naval-stores Region

1. *Utilization of worked-out turpentined trees for pulpwood.* One of the most important problems in forest management in the naval-stores region is the removal and utilization of worked-out turpentined trees. Recently much interest has been expressed in the development of pulp and paper plants and this may prove a very important outlet for this worked-out turpentine timber.

In order to determine the financial possibilities of cutting worked-out timber for pulpwood, a study was made of pulpwood production adjacent to an established paper mill in this region. This study showed that current stumpage prices for pulpwood range from 50 cents to $1.25 per cord of 160 cubic feet. It was also found that prices for pulpwood delivered at the paper plant were about $5.00 per cord.

Cutting and penning costs varied from $1.28 per cord for trees of 5-inch d.b.h. to 62 cents for trees of 14-inch d.b.h. These costs are based on the contractor's costs, which include labor, tools, and supervision of the foreman. Trucking cost per cord for a 12-mile haul was $1.39 and for a 26-mile haul, $2.63. Considering all costs, there was left for the 12-mile haul $2.38 per cord for profit and stumpage from trees 5 inches d.b.h. as compared to $3.05 per cord for 14-inch trees. In the 26-mile haul the margin for profit and stumpage for the same range of trees was between $1.10 and $1.76 per cord of 160 cubic feet of rough wood. All tree size classes studied showed a positive stumpage and profit value, although naturally the larger diameters showed a much greater margin than did the smaller diameters. This study, however, included utilization but did not take into consideration costs of producing the stumpage.

2. *Utilization of worked-out turpentined trees for stave bolts.* Analysis of the data from a preliminary investigation of the costs and returns of utilizing worked-out turpentined trees for rosin barrels in southeast Georgia indicates that size of tree has a marked effect upon cutting and manufacturing costs. Cutting costs varied from $1.54 per hundred cubic feet of rough wood, including bark (equivalent to 1.25 stacked cords of 38-inch wood), for trees 8 inches d.b.h. cut to a 5-inch top, to $1.06 for trees 13 inches d.b.h. cut to a 7-inch top. Costs of manufacture varied between $2.87 and $1.84 for similar tree sizes. Elements of costs in transportation are only slightly affected by size of tree, varying within the narrow limits of $1.54 to $1.46 per hundred cubic feet.

The values of trees for stave-bolt wood when calculated according to the current sales price of barrel staves (35 cents per barrel) ranged from $4.95 to $5.44 per 100 cubic feet of rough wood from 8- and 13-inch trees, respectively. The margin for stumpage, risk, and profit, which is the difference between sales price and production costs, was negative for trees below 10 inches d.b.h. For trees 10 inches and over, the margin for stumpage, risk, and profit increased with tree diameter from 7 cents per hundred cubic feet for 10-inch trees cut to a 6-inch top to $1.08 for 13-inch trees cut to a 7-inch top. This small margin indicates that the current stumpage prices of $1.00 to $1.25 per hundred cubic feet are too high for profitable operation in this class of timber. The results from this study are now being checked on other operations.

During 1936 it is planned to study the utilization of worked-out turpentined trees for lumber and other products.

3. *Sustained-yield management for naval stores in the longleaf and slash pine of the Southeast.* An intensive inventory and growth study on a sample 500 acres in south Georgia showed that when turpentining is begun at 9-inch d.b.h., trees can be worked profitably for the next 10 years continuously, using 5 years to each face without any rest period between faces. If trees were not turpentined until they attained a size of 11 inches d.b.h. it would allow 3 faces to be worked for a total period of 15 consecutive years. These larger trees would produce greater yields per face and their value for lumber and other products after being worked out for turpentine would also be much greater than if turpentining is begun at 9 inches.

During 1936 it is planned to continue study of costs and returns from turpentining trees of different sizes and to start a new study of costs and returns to be obtained from stands varying in numbers of working trees per acre.

NEW PUBLIC DOMAIN

The problems under the New Public Domain-Land Use Project include: (1) the relation of land ownership, tax delinquency, valuation, taxation, and public finance to forest-land use; and (2) the extent, location, and current status of tax delinquency in the South.

In the first study, detailed data were obtained during 1934-35 by field studies made in 11 counties in Florida and 9 in Georgia. These data cover the following areas of rural land:

Florida	4,593,238 acres
Georgia	3,172,263 acres
Total	7,765,501 acres.

The data are being analyzed and reports prepared under the titles "The Status, Cost, and Stability of Land Ownership" and "Governmental Organization and Public Finance in Relation to Land Use" for the areas studied in each of these two States.

The data on Florida Survey Unit #1 (21 counties in northeast Florida) show that: (1) there was relative uniformity in the 8 counties studied, as to size of rural properties held respectively by farmers, by real-estate operators, and by miscellaneous types of owners; (2) properties held by real-estate operators, naval-stores operators, and lumbermen averaged more than 1,000 acres each, while properties held by other types of owners averaged less than 200 acres each; (3) more than 90 percent of the total *number* of properties were 50 acres or less in area.

Farmer-owned properties tended to be assessed higher than those of other owners, with the exception of those owned by merchants and professional men, and by banks, loan and insurance companies, owing to the effect of improvements on the valuation of small properties, and to a more accurate assessment by the individual farmer than by the larger property holders. The tax per acre on property held by lumbermen and naval-stores operators varied considerably in the several counties, being highest (23 to 31 cents) in the nonlumber counties such as Suwannee and Alachua, and lowest (7-1/2 to 9-1/2 cents,) in the East Coast counties where taxes in general were highest. In general, the relation of tax per acre to rural land use appeared normal and equitable, improved farm land being taxed highest, followed in order by speculative land, timbered land, unimproved farm land, and cut-over land.

Forty-one percent of Florida Survey Unit #1 (4,046,738 acres) was in tax default for 3 or more years as of August 1934. Most of this default lay in the East Coast counties, and in Taylor County on the Gulf Coast, although no county had less than 5.3 percent of its area in default. In the 8 counties studied in the unit, relative stability of ownership among the various types of landowners ranked in ascending order roughly as follows: real-estate operators, "unknown" owners, naval-stores operators, lumbermen, "miscellaneous" owners, farmers, merchants and professional men, banks, loan and insurance companies.

In the second study, it was found that in 1934 the total area in tax default for 3 or more years in the States from Florida to eastern Texas and including Arkansas and eastern Oklahoma exceeded 31,500,000 acres, of which more than 19,600,000 acres (62 percent) were forest land. The *forest* area estimated to be in chronic tax default in each State in 1934 was as follows:

Florida	7,925,000	acres
Eastern Oklahoma	2,815,000	"
Georgia	2,700,000	"
Eastern Texas	2,610,000	"
Louisiana	1,720,000	"
Arkansas	965,000	"
Mississippi	800,000	"
Alabama	80,000	"
Total	19,615,000	"

A paper on "Tax Delinquency of Forest Land in Arkansas, 1932-33" will be published shortly as a bulletin by the Arkansas Agricultural Experiment Station, which cooperated in the study.

Plans for 1936 include, in order of priority: (1) the analyzing and reporting on field data obtained in the study of land ownership and public finance in Florida and Georgia; (2) extension of field work in the same study to other States, if funds are available; and (3) the continuation of the study of the extent and location of tax-delinquent land in the South and what can be done about it.

FOREST SURVEY

The Forest Survey of the United States as authorized by the McSweeney-McNary Act of May 22, 1928, was initiated in the South in the latter part of 1930. It includes an authoritative nation-wide inventory of the extent, location, and condition of forest lands; the quantity, kinds, quality, and availability of timber now standing on these lands; the rate of depletion through cutting, fire, insects, disease, and other causes; the current and probable future rate of timber growth and the productive capacity of forest area; and the present and probable future need for forest products in the different parts of the country by all classes of consumers, including many major industries. It also includes analysis of the relation of these findings to one another and to other economic factors as a basis in formulating policies, principles, and plans of forest-land utilization. It involves both field inventories and the adjustment and compilation of existing data from many sources.

The Forest Survey field work in the South has been progressing on a substantial scale during the last 3 years. Major emphasis has been placed on the line-plot inventory work in order that basic information could be obtained from all parts of the South within a relatively short time. Preliminary data have been released in condensed form as rapidly as reports could be prepared.

The progress of the Survey activities to December 31, 1935, is summarized in the following table:

Progress Report of the Southern Forest Survey as of December 31, 1935

State	Survey Units	Area	Field work completed	Computing work completed	Interpretive and unit report writing completed	Total completed weighted	Releases published
	Number	*Acres*	*Percent*				*Number*
Alabama	6	32,816,500	83	24	1	38	1
Arkansas	4	26,898,000	75	14	2	32	0
Florida	3	34,848,000	68	35	7	38	2
Georgia	5	36,787,600	90	22	3	40	7
Louisiana	5	31,077,100	100	34	2	47	0
Mississippi	5	29,664,600	100	46	12	55	2
Oklahoma	1	4,026,200	0	0	0	0	0
S. Carolina	3	18,163,900	33	12	1	16	2
Texas	2	18,515,900	100	29	2	46	1
Tennessee-Virginia[1]	1	1,852,400	100	90	45	80	1
Total	35	234,650,200					16
Average (weighted)			81	28	4	39	

[1] Norris Dam Watershed.

The field force on January 1, 1935, included 25 line-plot crews of 3 men each; in July 1935 this group was cut to 14 crews because of curtailment in emergency funds. At about the same time the field force assigned to industrial investigations was somewhat increased. There are 3 separate regional groups handling the bottomland-hardwood, pine-hardwood, and naval-stores regions, respectively. The Survey computing section was increased during 1935 by several operators to speed up the office end of the work.

As the field data accumulate and are analyzed it is possible to obtain, for the first time, a definite appraisal of the forest situation in the South. The following table gives a general idea of land uses as found in the Survey units completed to date:

Land-use Classes in 13 Survey Units

State and Unit	Forest land	Agricultural land			Other land, prairie, town rights-of-way, etc.	Total
		Cultivated	Idle and abandoned	Pasture		
	Acres					
Alabama[1] Units 1 & 2	5,732,000	1,572,600	301,900	247,500	265,100	8,119,100
Florida Unit 1	7,378,900	950,800	443,900	48,100	693,900	9,515,600
Georgia Units 1 & 2	10,076,600	4,109,400	562,700	82,600	465,800	15,297,100
Louisiana Units 1 & 4	4,090,600	1,198,900	113,800	113,900	169,900	5,687,100
Mississippi Units 1, 2, 4	9,616,500	5,958,000	1,341,700	1,185,600	513,100	18,614,900
S. Carolina Unit 1	2,993,000	1,447,400	379,300	31,400	335,800	5,186,900
Texas Unit 1	6,621,200	1,278,900	252,900	1,198,400	542,400	9,893,800
Tennessee-Virginia[2]	885,800	440,600	56,900	419,000	50,100	1,852,400
Total	47,394,600	16,956,600	3,453,100	3,326,500	3,036,100	74,166,900
Percent of total	64	23	5	4	4	100

[1] Exclusive of Geneva and Houston Counties, in Unit 1, Alabama.

[2] Norris Dam Watershed.

Forest Conditions

To obtain a better picture of the forest situation as a whole, the productive forest acreage of 13 Survey units has been subdivided into classes based on age, size, quality, and degree of cutting:

State and Unit	Forest area by condition[1]					
	Old growth		Sawlog size second growth		Under sawlog size second growth and reproduction	Clear-cut and fire-killed
	Uncut	Partly cut	Uncut	Partly cut		
	Acres					
Alabama[2] Units 1 & 2	253,600	738,800	1,390,700	392,400	2,587,600	366,600
Florida Unit 1	637,100	870,400	1,513,000	146,600	3,063,800	1,066,800
Georgia Units 1 & 2	515,400	1,100 900	2,881,000	477,500	4,382,300	713,100
Louisiana Units 1 & 4	635,900	949,100	860,600	236,000	1,115,300	268,400
Mississippi Units 1, 2, 4	241,600	747,800	1,995,500	901,500	4,977,100	753,000
S. Carolina Unit 1	217,800	233,900	1,106,700	227,400	1,190,300	16,900
Texas Unit 1	504,900	563,600	2,493,000	896,200	1,935,700	216,100
Tennessee-Virginia[3]	22,400	168,500	193,800	114,900	383,700	800
Total	3,028,700	5,373,000	12,434,300	3,392,500	19,635,800	3,401,700
Percent of total	6	11	27	7	42	7

[1] Excludes 128,600 acres of nonproductive forest land.

[2] Exclusive of Geneva and Houston Counties, in Unit 1, Alabama.

[3] Norris Dam Watershed.

Naval Stores

As line-plot work in the naval-stores units was completed, field data in the more important regions were assembled and the basic inventory data released. A summation of several of these reports covering the active naval-stores belt east of the Mississippi River is given:

Naval-stores Statistics, Season 1934-35

State and Unit	Survey Unit	Area of turpentine types	Area working	Number of cups hung	Number of turpentine stills	Number of gum producers without stills	Number of units produced [1]	Number employed in production
	Number	*------- Acres*	*-------*	*Thousands*				
S. Carolina	1	1,433,000	233,900	4,700	51	380	15,910	1,410
Georgia	1, 2	7,961,300	3,919,800	66,800	629	8,800	287,200	20,040
Florida	1	5,190,200	1,381,300	19,200	170	30	81,610	5,760
Florida) Alabama) [2]	2) 1)	7,073,800	1,510,000	24,400	234	1,530	86,030	7,320
Louisiana) Mississippi)	4) 4)	3,711,600	236,300	3,600	22	510	13,700	1,080
Total		25,369,900	7,281,300	118,700	1,106	11,250	484,450	35,610

[1] A naval-stores unit is made up of one 50-gallon barrel of turpentine and three and one-third 500-pound (gross) barrels of rosin.

[2] Includes Houston and Geneva Counties, Alabama.

Pulpwood

Recent activity in the paper industry has focused public attention on the southern pine forests as a permanent source of raw material. The following table summarizes the growing stock of timber of species used for pulping, in 12 Survey units:

Total Forest Growing Stock

State	Survey Unit	Pine pulpwood	Hardwood pulpwood	Total pulpwood	Productive forest area	Average stand
	Number	*Thousand cords*			*Acres*	*Cords per acre*
Texas	1	42,658	12,516	55,174	6,589,500	8.4
S. Carolina	1	17,451	10,718	28,169	2,993,000	9.4
Florida	1, 2	35,873	16,455	52,328	13,315,200	3.9
Alabama[1]	1, 2	26,374	11,018	37,392	5,729,700	6.5
Georgia	1, 2	43,010	118,596	61,606	9,990,200	6.2
Mississippi	2, 3, 4	53,539	29,567	83,106	13,906,000	6.0
Louisiana	4	7,128	4,526	11,654	1,624,000	7.2
Total		226,033	103,396	329,429	54,147,800	6.1

[1] Does not include Houston and Geneva Counties, Alabama.

Continuing the policy of releasing basic data on a Survey unit as soon as possible after the field inventory is completed, Releases Nos. 7 to 17, inclusive, were prepared and distributed in 1935. A brief report on the expansion of the pulp and paper industry, based on Survey figures, was released in September.

COOPERATING AGENCIES

BUREAU OF PLANT INDUSTRY

Forest Pathology

Brown-spot needle disease

The investigation of the brown-spot needle disease of longleaf pine seedlings continued as the main project. This study is divided into two separate investigations: (1) the effect of the disease on seedling development and (2) the use of fire as a method of disease control.

Siggers took leave of absence from the Station January 1 to June 30, 1935, to take graduate work at the University of Minnesota, and no new phases of this project were started during that period.

An examination of a longleaf pine plantation on the Choctawhatchee National Forest, in western Florida, where the brown-spot disease has been controlled by spraying during the past three seasons (1933-35), showed eight times more disease on the foliage of unsprayed seedlings than on that of the sprayed.

Studies at Bogalusa showed that a spray treatment of one season reduces infection on foliage of the following growing season. Two sets of planted seedlings were treated in the same way in 1934, except that one lot was sprayed in November and the other left unsprayed. During the following seven months no control measures were taken. In July 1935 the foliage of seedlings that were sprayed in November 1934 had an average infection of 3.3 percent compared with an 8.6 percent infection on needles of the unsprayed lot.

Studies of the effect of the disease on seedling growth have been carried on during the last several years by spraying at frequent intervals. Longleaf seedlings that have been sprayed for six consecutive seasons, ever since they were first planted in the field, averaged 90 inches in height by the end of the seventh season (1935), whereas height of unsprayed diseased seedlings of the same age in adjacent rows was only 4.8 inches.

Nursery diseases of black locust

Work on nursery diseases of black locust was resumed in May 1935 in cooperation with the Soil Conservation Service at the Robson, La., nursery. Treatments with bordeaux mixture as a foliage spray were initiated and, later, soil treatments with four chemicals were started. Soil treatments were also started at the State Forest Nursery at Woodworth, La., using 12 chemicals. Preliminary observations showed that formaldehyde was the most effective chemical in reducing the early losses that usually occur in black locust seedbeds.

Asiatic chestnut

As part of the program to establish blight-resistant chestnut trees in this country, Asiatic chestnut seedlings were grown and distributed from the State Nursery at Woodworth, La., from 1930 to 1934. A systematic study of the survival and growth of these trees and the pathological factors affecting their development is being made currently. During 1935 eight of these plantations of Asiatic chestnuts in Mississippi were examined. Considerable variation was found among different plantations and even among trees in the same plantation due to specific environmental and pathological conditions.

Forest Products Pathology

The major products-research problem during 1935 was a study of the methods by which sap stain is disseminated to the lumber. Research has also continued on the factors which influence the effectiveness of chemical antistain treatments, and additional tests have been made to determine the relative effectiveness of certain newly proposed chemical treatments.

The results from the dissemination studies show that an abundance of stain spores (seeds) are almost always present in the air in and around the sawmills and can get onto the lumber at any stage in its manufacture and storage. Spores from 20 different species of stain-producing fungi have been obtained in these studies. Since this stain inoculum is ever present, the lumber has little chance to remain bright (free from stain and mold) unless it is chemically treated or dried rapidly either in the kiln or in the drying yard.

Considerable stain is spread through the millyard not only by winds but also by various insects. Although certain beetles "consciously" carry the stain organisms with them, it appears probable that any insect can "accidentally" carry stain inoculum from infected to noninfected lumber. It has been observed that mites, and larvae and adults of certain insects, distribute the stain by getting spores on their bodies and then crawling on uninfected wood. Spiders, roaches, lizards, and various worms also accomplish this same "accidental" stain dissemination. In fact, any object which moves through the fruiting stain flora and then comes in contact with the surface of lumber can distribute the stain organisms. Green lumber is almost certain to become stained unless the surface can be quickly dried or unless it is chemically treated with a substance which will prevent growth of the stain organisms.

Considering mill practices which influence the occurrence of sap stain in lumber, a number of factors were noted which might be responsible for poor stain control. Some of these factors were:

1. Some mills do not maintain a fresh supply of stain-free logs.

2. Dipping solutions are not always prepared or maintained at proper strengths.

3. Unroofed vats allow dilution of the chemical by rain, and unroofed green chains and unprotected buggies allow rain washing of the lumber.

4. Faulty vat construction allows some lumber to go through the vat undipped or only partially dipped.

5. In some cases, especially at resaw or concentration yards, the lumber is not dipped soon enough after it is cut.

6. In many yards, adequate foundations are not provided for lumber piles.

7. When continuous flues are not provided in the piles the drying rate is cut down and stain is more liable to occur.

8. Adequate slant is not always provided for the piles.

9. Well-raised roofs are important, especially in rainy seasons. Although nonelevated roofs keep rain out of the piles, they also retard drying of the lumber in the pile.

Research with new chemicals of possible value for stain prevention added no unusually promising chemicals to the list of possible stain-control chemicals already known.

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Forest Tree Insects

Bark beetles

Surveys have been made of the status of *Ips* bark beetles in the Gulf States in relation to tornadoes, fire, and summer cutting. Very little evidence has come to light to show that summer cutting is not safe, particularly when rainfall is approximately normal. Common errors of foresters engaged in control operations were given in Southern Forestry Notes #13. A table was prepared for use of lumbermen and foresters, giving data on the most destructive forest insects common to the South.

Leaf-cutting ants

Early in the spring of 1935 a species of *Atta* caused considerable loss of young longleaf pine trees on the Evangeline Unit of the Kisatchie National Forest in central Louisiana by defoliating the newly planted trees. Sixty-four percent of the denuded trees were still alive in the fall of 1935, the survival being correlated with quality of site---the better the site, the better the survival. Carbon disulphide was used as a control measure in and around the nests. This proved effective until the young hardwood trees put out new leaves in late March, when the ants left the pines and went to this preferred food.

Tip moths

It is planned to institute some experimental plantings in 1936 to determine if damage from tip moth can be lessened through silvicultural methods.

Nursery Insects

White grubs

Very little damage has been caused by white grubs to pine seedlings in forest nurseries in the Gulf States during 1934 and 1935, except in Florida. A census shows that at least 25 species of these insects occur in this region.

Crop insects

Various insects which normally feed on crops attacked young black locust seedlings in forest nurseries in the Gulf States in 1934 and 1935; such attacks appear to be periodic.

Papers outlining control measures for two of the principal crop insects which injure locust were published.

Forest Products Insects

Ambrosia beetles

Extensive experiments with different chemical sprays and dips have been under way in cooperation with large chemical companies and the Bureau of Plant Industry to obtain chemicals which will prevent insect attacks in green lumber and green logs and at the same time prevent sap stain. One chemical was found to be effective in preventing beetle attack to green logs for periods up to two months. No chemicals have so far been effective in preventing beetle attack to green lumber.

Cone insects

Thirty-five different species of insects have been reared from 1- and 2-year-old southern pine cones during 1934 and 1935. Data are being tabulated on the type of injury and the principal injurious species.

Termites

At conferences where building officials of many cities in the eastern United States were present, efforts have been made to have city building codes include mandatory provisions which would protect householders from loss due to termite attack to buildings.

Model termiteproof buildings have been constructed in cooperation with the Southern Pine Association to demonstrate simple and inexpensive termite-proofing methods.

A map showing the distribution of termite damage to buildings in New Orleans was compiled from data in the files of local termite-control operators by students under F.E.R.A.

Detailed costs have been worked out on the installation of metal termite shields.

Extensive experiments with soil poisons have been installed in cooperation with two chemical companies at Crown Point, near New Orleans, La. So far one new chemical appears to be very promising.

Wood Preservatives

Tests of the effectiveness of chemical wood preservatives in protecting wood against termites have been installed at the Harrison Experimental Forest near Saucier, Miss. These tests will be enlarged from time to time, and complement very large-scale tests already under way all over the world.

Plans for 1936 will be largely a continuation of 1935 work.

BUREAU OF BIOLOGICAL SURVEY

Biological field investigations were started when a forest biologist was assigned to the Southern Station in April 1935. The first studies were limited to a determination of the effect of rodents and birds on the natural reproduction of longleaf pine in this region, and the working out of control measures that would prevent the destruction of the seed and seedlings by these agencies. The Harrison Experimental Forest in southern Mississippi was selected as the most advantageous place to carry on this work, particularly as there was an unusually heavy longleaf seed crop on this area in the fall of 1935.

As rodents had previously been blamed for much of the destruction of longleaf seed, a study was made of the distribution and abundance of rats and mice in typical cut-over longleaf pine land where seed trees were present. Some of the results of this study will be briefly summarized here.

The procedure followed was one that has been used in past years in the southern Appalachians in wildlife distributional studies. Circular quarter-acre plots were laid out on areas considered characteristic of poorly stocked longleaf pine lands, and intensively trapped for 10-day periods, 40 traps being used on each plot. Where trapping was carried on in freshly burned areas, check plots were established on areas unburned for a period of 2 or more years. A total of 20 plots was laid out, and as many as 4 were in operation at one time, which meant that for a period of a month or more 160 traps were in use each night. Despite the intensity of the trapping, surprisingly few rodents were caught. In fact, on 15 of the 20 plots not a single rat or mouse was caught, while 4 of the remaining 5 plots yielded but 1 rodent apiece. The single exception was on an area unburned for the past 5 years and covered with a heavy growth of grass, where 5 cotton rats were caught in 10 nights of trapping.

The only conclusion to draw at this time is that rodents on the Harrison Experimental Forest are scarce. Whether this is true throughout the surrounding territory, as well as in the longleaf pine areas of other Southern States from Texas to Florida, can be determined only by additional distributional studies. It is possible that under existing conditions rodents are always scarce. On the other hand, it is also possible that 1935 was a year when rats and mice, which are known to have definite cycles of abundance and scarcity, were at a low ebb as far as numbers were concerned. Further trapping work in the next 2 or 3 years should help to determine this.

After it was found that rodents were probably not going to be an important factor in limiting longleaf reproduction on the Harrison Experimental Forest during 1935-36, plans were made to study the effect of birds on longleaf seeds and seedlings during the winter months. Blackbirds, meadowlarks, and mourning doves, as well as certain species of sparrows, winter in large numbers in the Gulf States, and may be an important factor in destroying longleaf pine reproduction. Where they are suspected of eating the seed in any quantities, a sufficient number will be taken and their stomach contents analyzed to establish their guilt or innocence beyond any question. Should any of these bird species prove guilty of serious damage to the seed crop, then efforts will be made to work out preventative measures that will protect the seed without injuring the birds. As these birds are protected by both Federal and State laws, special arrangements would need to be made before control measures could be applied.

FOREST-RESEARCH NEEDS IN THE SOUTHERN BOTTOMLAND HARDWOOD REGION

The southern bottomland hardwood forest, covering about 50 million acres of forest land, located in part in the Mississippi Delta but also to a considerable extent along the river bottoms in every Southern State, is the one major forest region in the United States in which practically no forest research has been conducted. From these 50 million acres comes one half or more of the total national production of hardwoods, including the larger part of such highly important and valuable species as oak, red gum, ash, tupelo, cypress, hickory, cottonwood, and elm. In this important region, which annually yields timber products valued at more than $100,000,000, many problems confront the timberland owner who is interested in keeping his land productive by growing a continuous crop of timber. While considerable areas of cut-over hardwood lands have been cleared for agriculture, it is generally acknowledged that a large proportion of the present uncleared land will remain available for timber growing.

The southern bottomland hardwood forests have been greatly changed by cutting and fire and only a few large reserves of uncut hardwood timber remain. Most of these forest lands are in some stage of regrowth following cutting. Because of favorable climatic and soil conditions, rate of tree growth is generally very favorable. If these cut-over hardwood areas could be restored to commercial productivity, forest industries and many communities within the region could be put on a more permanent and self-sustaining basis than at present. Developing the best methods of maintaining or restoring the productivity of these hardwood forest lands is a major research problem in forest management. The problem is very complex because of the large number of tree species involved, the periodic overflows, and the widespread distribution of the hardwoods throughout the pine reigon.

Research results for the bottomland hardwood forests, to be of most practical use, should be made available within a reasonable length of time. Although some long-time studies are essential, the major need is for studies that will yield definite and reliable results within a short space of time. If a carefully planned forest-research program were instituted, owners of hardwood timberlands could expect definite information upon which sound forest-management policies can be based. Following are some of the problems for which answers are needed:

1. *Growth and yield of southern hardwoods.* This phase of hardwood forest research would involve a determination of average rates of tree growth in volume and in quality, for all species and for typical stands of all major forest types. This information is essential in formulating plans for sustained-yield management, which is the aim of every forestry enterprise.

2. *Forest management of southern hardwoods.* This would include a determination of methods that will insure satisfactory natural regeneration of existing stands or cut-over areas. For example, an important current problem involves methods of securing adequate regeneration on backwater areas and of cottonwood on batture lands. Practical methods of stand improvement and thinnings need to be worked out. Special emphasis should be given to the problem of how to cut forest stands so as to assure a future growth of desirable hardwood species. The influence of grazing must be ascertained. The effect of fires on hardwood forests and the methods and costs of their prevention and control should also be studied. Forest-management investigations would determine the measures necessary to insure maximum continuous growth of hardwood forest products in quantity and quality.

3. *Wood utilization.* Studies are needed to determine the practicability of integrated forest utilization to assure maximum returns from various log grades, sizes, and species of trees, including the suitability of southern hardwoods for sawlogs, stave bolts, railroad ties, wood pulp, chemical wood, fabricated products, and special uses.

4. *Financial aspects of growing hardwood timber.* Studies are needed to determine average costs of logging and transporting various forest products. These costs will vary with size and quality of the timber, the amount per acre, and the different species involved, as well as the methods used. The value of trees for different commodities needs to be ascertained. Hardwood log grades should be established comparable to those used for lumber grading. Forest-taxation problems need study and remedies should be worked out to secure equitable taxation of forest lands.

5. *Special problems.* Insect, disease, and biological problems as related to forests and forest products need study. These problems should be investigated currently, in cooperation with the various specialists detailed to carry on such studies.

ARTICLES PUBLISHED OR SUBMITTED FOR PUBLICATION

January 1, 1935 - December 31,1935

BICKFORD, C. A. - A simple, accurate method of computing basal area of forest stands. Journal of Agricultural Research 51 (5): 425-434. September 1, 1935.

__________ and BULL, HENRY. - A destructive forest fire and its implications. Occasional Paper No. 46, 4 pp. April 15, 1935.

BOND, W. E., and SPILLERS, A. R. - Use of land for forests in the Lower Piedmont Region of Georgia. Occasional Paper No. 53, 47 pp., 21 tables, 2 figs., appendix (2 tables). November 20, 1935. (Published in "Georgia Land Use Problems," Georgia Experiment Station Bulletin 191, pp. 126-157, illus. (May 1935), under title, "The place of forests in the economy of the Lower Piedmont.")

BULL, HENRY. - Thinnings in southern pines. Progressive Farmer and Southern Ruralist 50 (3): 15. March 1935.

__________ - Thinning loblolly pine in even-aged stands. Journal of Forestry 33 (5): 513-518. May 1935.

__________ and CHAPMAN, R. A. - Killing undesirable hardwoods in southern forests. Occasional Paper No. 50, 21 pp., 6 tables, bibliography. September 18, 1935.

CHAPMAN, R. A. - Review of "Multiple correlation analysis as applied to farm-management research," by Stanley W. Warren (Cornell University, Agricultural Experiment Station Memoir No. 141, May 1932). Journal of Forestry 33 (1): 91. January 1935.

CRAIG, RONALD B.	- The extent of tax default in the Gulf States in 1934. Occasional Paper No. 49, 21 pp., 10 tables, fig. August 25, 1935.
————————	- The South's no-man's land. American Forests 41 (12): 684-685. December 1935.
DAVIS, V. B.	- Rate of growth in a selectively logged stand in the bottomland hardwoods. Occasional Paper No. 41, 9 pp., 5 tables. January 21, 1935. Journal of Forestry 33 (6): 610-615. June 1935.
DEMMON, E. L.	- The opportunity for forestry in southern agriculture. Proceedings of 35th Annual Convention, Association of Southern Agricultural Workers, Memphis, Tenn., January 31 - February 1-2, 1934, pp. 177-180. (Published 1935.)
————————	- The silvicultural aspects of the forest-fire problem in the longleaf pine region. Address delivered at annual meeting of the Society of American Foresters, January 30, 1935. Journal of Forestry 33 (3): 323-331. March 1935.
————————	- Obituary. Henry E. Hardtner. Journal of Forestry 33 (10): 885-886. October 1935.
ELDREDGE, I. F.	- Administrative problems in fire control in the longleaf-slash pine region of the South. Address delivered at annual meeting of the Society of American Foresters, January 30, 1935. Journal of Forestry 33 (3): 342-346. March 1935.
————————	- The Forest Survey in the South. Journal of Forestry 33 (4): 406-411. April 1935.
————————, SPILLERS, A. R., and KAHLER, M. S.	- The expansion of the pulp and paper industry in the South. Southern Forest Experiment Station, mimeographed, 17 pp. August 5, 1935. Released September 16, 1935.
FOREST SURVEY STAFF.	- Report of the Forest Survey on the land classes in the Norris Dam Watershed in Tennessee and Virginia. Release No. 7, 8 pp., 6 tables. January 7, 1935.
————————	- The supply and status of naval-stores timber in Survey Unit #1, Florida. Release No. 8, 12 pp., 6 tables, fig. January 12, 1935.
————————	- Advance information on the supply of pulpwood in Survey Unit #1, Florida. Release No. 9, 13 pp., 6 tables, fig. January 30, 1935.

FOREST SURVEY STAFF. - Advance information on the supply of pulpwood in Survey Unit #1, South Carolina. Release No. 10, 11 pp., 7 tables, 2 figs. February 23, 1935.

__________ - Pulping and nonpulping cordwood volume in Survey Unit #2, Mississippi. Release No. 11, 9 pp., 5 tables, 3 figs. April 11, 1935.

__________ - Pulping and nonpulping cordwood volume in Survey Unit #2, Georgia. Release No. 12, 12 pp., 7 tables, 2 figs. April 25, 1935.

__________ - The supply and status of naval-stores timber in Survey Unit #2, Georgia. Release No. 13, 10 pp., 8 tables, fig. May 6, 1935.

__________ - The quantity and status of naval-stores timber in Survey Unit #1, South Carolina. Release No. 14, 10 pp., 9 tables, fig. June 15, 1935.

__________ - Pulping and nonpulping cordwood volume in Survey Unit #1, Texas. Release No. 15, 10 pp., 4 tables, 3 figs. August 15, 1935.

__________ - Pulping and nonpulping cordwood volume in the southwest Alabama Survey area. Release No. 16, 12 pp., 6 tables, 2 figs. October 18, 1935.

__________ - Statistics on gum naval stores production. Release No. 17, 13 pp., 10 tables, fig., 4 charts. December 31, 1935.

HARPER, V. L. - A plotting board as an aid in analyzing quantitative data. Journal of Forestry 33 (2): 176-177. February 1935.

HATFIELD, IRA. - Mill practices that influence the occurrence of sap stain in lumber. Southern Lumberman 151 (1905): 38-40, 3 figs., bibliography. August 15, 1935. Southern Lumber Journal 39 (9): 26-28, 3 figs. September 10, 1935. American Lumberman 3057: 34-35, 5 figs. (*reprints* have bibliography added). September 28, 1935.

HEPTING, GEORGE H. - Decay following fire in young Mississippi Delta hardwoods. U. S. Dept. Agr. Tech. Bull. No. 494, 32 pp., illus. December 1935.

HUBERMAN, M. A. - Increasing tree percentage at the Stuart Forest Nursery. Planting Quarterly, U. S. Forest Service, pp. 16-17. January 1, 1935.

__________ - A seedling measurement board. Occasional Paper No. 44, 4 pp., illus. March 20, 1935.

——————— - Mechanical advances at the Stuart Forest Nursery. Occasional Paper No. 48, 8 pp., 5 figs. August 1, 1935.

——————— - Machine sows seed. Aim at annual production of 50 million trees calls for advance planting. Forestry News Digest, p. 14. September 1935.

McKellar, A. D. - The effects of eleven inches of rain on the Stuart Forest Nursery. Journal of Forestry 33 (9): 822-823. September 1935.

Meginnis, H. G. - Tree planting to reclaim gullied lands in the South. Proceedings of 34th Annual Convention, Association of Southern Agricultural Workers, New Orleans, La., February 1-3, 1933, pp. 138-139. (Published 1935.)

——————— - Influence of forest litter on surface run-off and soil erosion. Bulletin 16, Report of the Fifteenth Annual Meeting of the American Soil Survey Association, pp. 115-118, illus. May 1935.

——————— - Losses of black locust planting stock in storage. Journal of Forestry 33 (5): 534-535. May 1935.

——————— - Effect of cover on surface run-off and erosion in the loessial uplands of Mississippi. U. S. Dept. Agr. Circ. No. 347, 16 pp., illus. June 1935.

——————— - Sulphuric acid treatment for black locust seed. Occasional Paper No. 47, 4 pp. June 25, 1935.

Osborne, James G., and Schumacher, Francis X. - The construction of normal-yield and stand tables for even-aged timber stands. Journal of Agricultural Research 51 (6): 547-564, illus. September 15, 1935.

Pessin, L. J. - Root habits of longleaf pine seedlings. Occasional Paper No. 43, 7 pp., 2 tables, 2 figs., chart. February 20, 1935.

——————— - Effect of density of stocking on growth of longleaf pine. Naval Stores Review 45 (8) 15. May 25, 1935.

——————— - A new use for longleaf pine needles. Service Bulletin 19 (14) 3-4. July 14, 1935.

Siggers, Paul V. - Slash-diposal methods in logging shortleaf pine. Occasional Paper No. 42, 5 pp., 4 illus. February 7, 1935.

Snyder, Thos. E. - Methods of recognizing termite infestation. Flying termites sure sign. Railway Engineers and Maintenance 31 (4): 235-236. April 1935.

SNYDER, THOS. E. - An introduced anobiid beetle destructive to houses in the Gulf States. Proc. Biol. Soc. Wash. 48: 59-60. May 3, 1935.

—————— - Termite control. Delivered before conference of the Building Officials of America, May 9, 1935. Wood Preserving News 13 (9): 115-119, 128. September 1935.

—————— - What, where, when and why are termites? Occasional Paper No. 52, 6 pp., 2 illus. October 15, 1935. Southern Lumberman 151 (1910): 35-37. November 1, 1935.

—————— - The *Ips* engraver beetle in the South. Naval Stores Review 45 (32): 15. November 9, 1935.

—————— - Termite research in the United States. Skyscraper Management 20 (11): 5-6, 28-30. November 1935. The Exterminators' Log 3 (12): 7-8. December 1935.

—————— - Our enemy the termite. 196 pp., illus. Comstock Publishing Company, Inc., Ithaca, N. Y. December 1935.

——————
and
HUNT, GEO. M.
(senior author) - An international termite exposure test---sixth progress report. Proceedings of the Thirty-first Annual Meeting of the American Wood-Preservers' Association, New York City. January 22-24, 1935, pp. 264-278.

——————
and
LAMB, H. N. - Membracid girdling of young black locust seedlings in southern Louisiana and Mississippi. Louisiana Conservation Review 4 (6): 9-10, 47. April 1935.

SOUTHERN FOREST
EXPERIMENT
STATION. - Southern Forestry Notes #9. February 1935.

—————— - Southern Forestry Notes #10. March 1935.

—————— - Southern Forestry Notes #11. May 1935.

—————— - Southern Forestry Notes #12. July 1935.

—————— - Southern Forestry Notes #13. October 1935.

—————— - Southern Forestry Notes #14. December 1935.

SPILLERS, A. R. - Pine straw used in strawberry culture. Southern Agriculturist 45 (1): 23. January 1935.

WAHLENBERG, W. G. - Fire in longleaf pine forests. Occasional Paper No. 40, 4 pp. January 9, 1935.

—————— - Effect of fire and grazing on soil properties and the natural reproduction of longleaf pine. Address delivered at annual meeting of Society of American Foresters, January 30, 1935. Journal of Forestry 33 (3): 331-338. March 1935.

Wakeley, Philip C. - Notes on the life cycle of the Nantucket tip moth, *Rhyacionia frustrana* Comst., in southeastern Louisiana. Presented before New Orleans Academy of Sciences, New Orleans, La., on March 23, 1934. Occasional Paper No. 45, 8 pp., table, 4 figs. April 2, 1935.

____________ - Mice and men (more comments). Service Bulletin 19 (13): 3-4. June 24, 1935.

____________ - Collecting, extracting, and marketing southern pine seed. Occasional Paper No. 51, 10 pp., 3 tables, 2 figs. October 3, 1935. Naval Stores Review 45 (27): 6. October 5, 1935.

____________ - Artificial reforestation in the southern pine region. U. S. Dept. Agr. Tech. Bull. No. 492, 115 pp., illus. November 1935.

Winters, Robert K., and Osborne, James G. - Growth and yield of second-growth red gum in fully stocked stands on alluvial lands in the South. Occasional Paper No. 54, 12 pp., 3 tables, 4 figs., appendix (A and B). December 4, 1935.

Wyman, L. - Turpentine pines need growing space. Service Bulletin 19 (18): 4-5. September 2, 1935.

____________ - Management of farm woodlands for naval stores production. Proceedings of 34th Annual Convention, Association of Southern Agricultural Workers, New Orleans, La., February 1-3, 1933, pp. 135-137. (Published 1935.)

RADIO ADDRESSES

Craig, Ronald B. - Forest land planning in the South. Station WWL, June 8, 1935.

____________ - Extent of tax default in the Gulf States in 1934. Station WWL, August 3, 1935.

Huberman, M. A. - Fifty million trees for Uncle Sam. Station WWL, January 26, 1935.

____________ - Southern forests for recreation. Station WWL, February 23, 1935.

Lehrbas, M. M. - The nation-wide forest survey. Station WWL, January 10, 1935.

Olsen, C. F. - Facts about cypress. Station WWL, March 30, 1935.

Osborne, James G. - Forestry research in the naval stores region. Station WTAL (Tallahassee, Fla.), November 22, 1935.

Wakeley, Philip C. - Progress toward the establishment of an arboretum in New Orleans. Station WWL, May 11, 1935.

3.27.

AGRICULTURAL REFERENCE DEPARTMENT
[illegible] LIBRARY

SOUTHERN FOREST EXPERIMENT STATION

E. L. Demmon, Director

New Orleans, La.

SIXTEENTH ANNUAL REPORT

Jan. 1, 1936 - Dec. 31, 1936

STAFF

SOUTHERN FOREST EXPERIMENT STATION

JANUARY 1, 1936- DECEMBER 31, 1936

Permanent Personnel

E. L. Demmon	Director
I. F. Eldredge	Prin. Forest Economist
W. E. Bond	Sr. Forest Economist
Frank A. Ineson	Forest Economist
W. G. Wahlenberg	Forester
R. K. Winters	Forester
V. L. Harper	Silviculturist
Mark M. Lehrbas	Silviculturist
H. G. Meginnis	Silviculturist
P. C. Wakeley	Silviculturist
Richard W. Nelson	Taxation Economist
Henry Bull	Assoc. Silviculturist
E. W. Gemmer	Assoc. Silviculturist
J. G. Osborne	Assoc. Silviculturist
L. J. Pessin	Assoc. Forest Ecologist
R. B. Craig	Assoc. Forest Economist
J. W. Cruikshank	Assoc. Forest Economist
V. B. Davis	Assoc. Forest Economist
E. B. Faulks	Assoc. Forest Economist
J. A. Putnam	Assoc. Forest Economist
R. R. Reynolds	Assoc. Forest Economist
A. R. Spillers	Assoc. Forest Economist
P. R. Wheeler	Assoc. Forest Economist
R. E. Worthington (transferred to Central States Forest Expt. Station 11/15/36)	Assoc. Forest Economist
W. E. Houser (transferred to Appalachian Forest Expt. Station 6/30/36)	Assoc. Timber Expert
C. A. Bickford	Asst. Silviculturist
Roy A. Chapman	Asst. Silviculturist
F. D. Heyward	Asst. Silviculturist
T. A. Liefeld	Asst. Silviculturist
C. F. Olsen	Asst. Silviculturist
George E. Morrill	Asst. Forest Economist
Harry F. Smith	Asst. Forest Economist
Wm. S. Stover	Asst. Forest Economist
Halsey M. Hicks	Junior Forester
Morris A. Huberman	Junior Forester
T. E. Maki (transferred to Intermountain Forest and Range Expt. Station 5/16/36)	Junior Forester
George B. Ward, Jr.	Junior Forester
T. E. Pease	Sr. Forest Ranger
John A. Lubbe	Sr. Admin. Assistant
Vera S. Lind	Sr. Clerk
Coel W. Mills (appointed 7/13/36)	Forest and Field Clerk
Camelia M. Larsen	Clerk
Clark H. Streetman	Clerk

Marie M. Flad	Clerk-Stenographer
Agnes G. Terburg	Clerk-Stenographer
Mary R. Craig	Asst. Clerk
Lucille P. Olsen	Asst. Clerk
Elizabeth Bergland	Asst. Clerk-Stenographer
Ruth Marshall	Asst. Clerk-Stenographer
Marvel H. Gallacher	Jr. Clerk-Stenographer
May M. Patchett	Jr. Clerk-Stenographer
Ruth H. Angelo (resigned 3/9/36)	Telephone Operator
Iretta C. Austin (appointed 3/20/36)	Telephone Operator
William G. O'Regan (resigned 2/29/36)	Junior Messenger

STAFF OF COOPERATING FEDERAL BUREAUS

BUREAU OF PLANT INDUSTRY

P. V. Siggers	Assoc. Pathologist
Ira Hatfield (resigned 6/4/36)	Asst. Pathologist
A. F. Verrall (appointed 12/28/36)	Asst. Pathologist
Howard Lamb	Junior Pathologist

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

T. E. Snyder	Sr. Entomologist
Ruth E. Wood (appointed 7/1/36)	Asst. Clerk-Stenographer

BUREAU OF BIOLOGICAL SURVEY

Thomas D. Burleigh	Assoc. Biologist

TEMPORARY TECHNICAL STAFF

Oran Raber (transferred from Washington 12/1/36)	Conservationist
Norman E. Hawes (transferred to Appalachian Forest Expt. Station 12/31/36)	Asst. Forester
Joseph Yencso (transferred to Region 8, 7/9/36)	Asst. Forester
A. H. Antonie	Junior Forester
M. H. Collet (appointed 11/16/36)	Junior Forester
T. C. Evans	Junior Forester
A. D. McKellar (resigned 10/25/36)	Junior Forester
Ike Rawls	Asst. Technician
A. L. Shepard	Asst. Technician
Felix Bailey	Squad Foreman
James M. Black (from 1/2 to 7/31/36)	Squad Foreman

TECHNICIANS ASSIGNED TO SURVEY

R. S. Andrews
C. H. Carr (transferred to Appalachian Forest Expt. Station 7/15/36)
John Earley (resigned 3/31/36)
J. P. Hale, Jr. (transferred to Appalachian Forest Expt. Station 7/17/36)
J. P. Johnson (transferred to Region 8, 7/15/36)
M. S. Kahler (resigned 9/2/36)
F. J. Lemieux (appointment terminated 10/28/36)
W. F. Mershon (transferred to Appalachian Forest Expt. Station 7/17/36)
R. L. Mosely (transferred to Appalachian Forest Expt. Station 7/17/36)
J. R. Nevers (transferred to Region 8, 7/25/36)
D. G. O'Kelley (transferred to Appalachian Forest Expt. Station 7/15/36)
L. E. Price (appointment terminated 10/20/36)
C. O. Scott
A. G. Steedley (transferred to Region 8, 7/15/36)
W. H. Thompson (transferred to Region 8, 7/15/36)
J. M. Tinker (transferred to Region 8, 7/8/36)
A. D. Toler (transferred to Appalachian Forest Expt. Station 7/16/36)
W. J. Welsh (transferred to Region 8, 7/13/36)
N. M. White (transferred to Appalachian Forest Expt. Station 7/14/36)
R. E. Womack (appointment terminated 6/15/36)
W. E. Wright (transferred to Region 8, 7/15/36)

CONTENTS

Page

Introduction.. 1
Watershed protection - a major problem.................................. 1
Experimental forests... 4

Current investigations and plans for 1937:

- Forest management investigations.............................. 5
  - Regeneration.. 7
  - Fire.. 9
  - Naval stores.. 10
  - Silviculture.. 11
  - Fundamental studies................................... 14
  - Mensuration... 16
- Forest influences... 16
- Forest economics.. 19
  - Financial aspects of private forestry................. 19
  - New public domain..................................... 25
  - Forest taxation 27
- Forest survey... 27
- Cooperating agencies.. 32
  - Bureau of Plant Industry.............................. 32
    - Forest pathology.............................. 32
    - Forest-products pathology..................... 34
  - Bureau of Entomology and Plant Quarantine............. 35
    - Forest insects................................ 35
    - Nursery insects............................... 35
    - Forest-products insects....................... 36
    - Wood preservatives............................ 37
    - General....................................... 37
  - Bureau of Biological Survey........................... 38
    - Damage to longleaf pine by birds and rodents.......... 38
    - Distribution of rodents on cut-over longleaf pine areas 38
    - Damage caused by rabbits...................... 39
    - Distribution of birds on the Gulf Coast....... 39

Publications.. 40

SIXTEENTH ANNUAL REPORT
of the
SOUTHERN FOREST EXPERIMENT STATION
January 1, 1936- December 31, 1936

INTRODUCTION

In this report the progress of the forestry investigations made at he Southern Forest Experiment Station during 1936 is summarized, and the lans for research during 1937 are outlined. This Station, which was esablished in July 1921, serves 135 million acres of commercial forest land n Florida, Georgia, Alabama, Mississippi, Louisiana, Arkansas, Oklahoma, nd Texas. Here research is being carried on in the fields of reforesttion, silviculture, fire protection, forest economics and land use, and ther related subjects. The results of this research should serve as the asis for the scientific practice of forestry and thus promote the full se of this immense forest area both for timber growing and for associated urposes such as watershed protection, recreation, and game management.

WATERSHED PROTECTION--A MAJOR PROBLEM

Throughout the Southern States the regulation of streamflow, paricularly with a view to lessening flood discharges, is a major problem. he problem is one of water control, the objective being to obtain maxium infiltration and storage of rainfall in the soil. Measures to achieve ater control are, however, likely to be exceedingly varied throughout the outhern States, since they must apply on the one hand to the humid wellatered Southeastern States, where mitigation of flood damage is of major mportance, and on the other hand to the semi-arid forest-range lands of est-central Texas and Oklahoma, where floods are also frequent but where ater supplies for domestic and industrial use are critically low.

In this extensive region, there are two broad types of measures peraining to land use that should prove effective: (1) those relating to the estoration of forest and plant cover on devasted areas and to improvement f existing cover on forest and wild lands; and (2) correct management pracices on all lands so as to utilize fully in proper relation to other uses he watershed protection provided by forest and plant cover.

Measures of the first category are especially needed because of the xtent to which land abuse and abandonment have progressed. No other secion of the United States has a greater proportionate acreage of deterioated lands--chiefly as a result of farm abandonment--than does that of he Gulf States. This is also a region of vast areas of cut-over timberands, on which the remaining forest, because of lack of fire protection r lack of proper management, is undergoing further deterioration.

Measures of the second category are no less important than those just mentioned, and require for their successful execution thorough understanding of desirable management practices on all forest and wild lands where watershed values are represented.

Many problems are involved in watershed protection. Clearly, measures which will promote reestablishment of plant cover on the barren or sparsely vegetated areas and which will bring about an increase in density of existing natural cover are of the first moment. Desirable and appropriate management practices have not yet been worked out, since the solution of these problems requires research on fundamental aspects concerning the interrelations between forests and the complex phenomena of rainfall disposition and stream behavior.

One of the obstacles to enacting a program of research designed to provide basic facts and principles is the general lack of recognition of the need of fundamental studies. While reforestation of barren and eroded areas and forest-improvement measures are generally considered as types of work requiring investigative effort, the need for research on the effect of silvicultural and utilization practices on stream behavior is not so well recognized. There is a general belief that watershed protection will be attained if conservative cutting practices are adopted and fire-protection measures are taken. Such a viewpoint overlooks the complexity of the relationships involved and the inadequacy of present knowledge with respect to the influence of the forest on the water cycle.

The methods worked out so far for watershed improvement are relatively costly, judged by the usual standards for improvement work on forest lands. Because of the low value of the devastated lands and, even more important, because of the extensive area of the lands which require remedial action, there is urgent need to work out minimum measures that can be applied simply and cheaply and that will result in the establishment of a satisfactory forest cover. Such measures may take the form of partial forest plantings, located strategically and established with special care, or of special protective or site-improvement treatments designed to promote natural revegetation over a period of years. In any event it would seem that simple minimum-requirements measures offer the best practicable solution of obtaining watershed protection for an enormous area of deteriorated lands in the South.

Studies are needed also to determine the relation of cover-restorative measures to rainfall disposition and stream behavior, since some standard other than mere rate and character of cover establishment is needed if the relative effectiveness of various watershed-improvement measures is to be accurately determined. Some such criterion is particularly needed if their application to extensive public projects is to be justified.

The usefulness of forest-engineering measures for temporary storage of surface water and for the protection and regulation of stream channels should also be determined. Investigations of this kind are particularly needed in the Ouachita Mountain region of Arkansas and Oklahoma where control of torrential streamflow during periods of heavy rainfall gives rise to special problems in water control. Similar studies also appear to be needed in the cedar breaks and central-plateau regions of Texas and Oklahoma, although the problems there are as yet largely unexplored.

Investigations of the relation of silvicultural and forest-management practices to streamflow should be undertaken soon not only because they are of fundamental importance to the problem but also because they are mainly long-term in character and cannot be expected to yield satisfactory results in a short time. These studies should aim to correlate stream behavior (peak flows, specifically) with varying forestry practices on actual watershed units, thus determining cause-and-effect relationships. More intensive supplementary studies are needed to evaluate the relationship between forests and floods.

Thus far, intensive water-cycle studies, confined to north Mississippi, have dealt only with one phase of the water cycle, i.e., surface run-off of rainfall. This is a highly important factor in floods and one which experiments have shown to be markedly influenced by cover-alteration treatments; more studies of this kind are needed, especially those which will furnish data on surface run-off from natural drainage units for various types of cover and land use. Another major need in the field of water-cycle studies is for investigations of ground water as related to forest lands. In the past little attention has been paid to ground-water drainage as a factor in floods or to the extent to which ground water may be affected by the forest, either beneficially or adversely. The extent to which shallow ground-water drainage contributes to stormflow discharges from watersheds needs to be determined in order to appraise properly the regulatory influence of forest cover and modifying agencies on streamflow.

Still another highly important element in the water cycle that needs investigative appraisal is that portion of the rainfall which is retained on a watershed and hence is subject to consumptive use and cannot augment flood volumes. Studies of this type are needed to indicate the moisture-retaining capacity of various litter and ground-cover types, interception of rainfall by arboreal vegetation, field-moisture capacities of representative soils, water movement through soil profiles, and evapo-transpirational draft by various types of vegetation. They are especially needed in the deep-soil regions of the Coastal Plain of the Southeast and in the semi-arid regions of Texas and Oklahoma, where consumptive use by natural vegetation is likely to account for a relatively large portion of total rainfall supplies. Investigations of this phase of the water cycle, when conducted along with run-off investigations, therefore, will throw much light on the question of how forests influence streamflow and on the more specific problems of how to regulate streamflow through forestry measures.

EXPERIMENTAL FORESTS

A comprehensive plan has been prepared for a system of experimental forests which will adequately meet the forest-research needs in the eight Southern States from Georgia and Florida on the east to Texas and Oklahoma on the west. The plan calls for experimental forests well distributed as to principal forest types and soil conditions. While the main purpose of an experimental forest is to serve as a research center for a particular forest subregion, its value for demonstrating good forestry practices and for "selling" research results should not be overlooked. In order that the experimental forests in the South might best serve these purposes, they are being selected as shown in the following table:

Present Experimental Forests

Name	Location	General forest type	Soil province (after Bennett)
Irons Fork	Ouachita National Forest, Ark.	Shortleaf-loblolly-hardwoods	Appalachian and Ozark Mountains
Crossett[1]	Crossett, Ark.	do	Upper Coastal Plain
San Jacinto	Sam Houston National Forest, Tex.	do	do
Palustris[1]	Kisatchie National Forest, La.	Longleaf-slash	do
Harrison[1]	DeSoto National Forest, Miss.	do	do
Olustee[1]	Osceola National Forest, Fla.	do	Flatwoods
Camp Pinchot	Choctawhatchee National Forest, Fla.	do	Deep sands
Chewalla	Holly Springs National Forest, Miss.	Upland hardwoods	Loessal uplands and Upper Coastal Plain

[1] Final approval received; action pending on others.

Proposed New Experimental Forests

Suggested location	General forest type	Soil province
Flood-control area, La., or Delta National Forest, Miss.	Bottomland hardwoods	Alluvial soils
Black Warrior National Forest, Ala.	Shortleaf-loblolly-hardwoods	Appalachian and Ozark Mountains
Resettlement Administration area, Ga.	do	Piedmont
Conecuh National Forest, Ala.	Longleaf-slash	Upper Coastal Plain

CURRENT INVESTIGATIONS AND PLANS FOR 1937

FOREST MANAGEMENT INVESTIGATIONS

During 1936, much time of the Forest Management personnel was devoted to a number of pressing problems in connection with silviculture on the national forests and with various Federal, State, and private forestry activities, with special reference to naval stores, fire, planting, regeneration, and stand improvement. Many of the data drawn upon had been gathered too recently to be published and made available to the various agencies interested, and some required new presentation for the immediate purpose at hand. Notwithstanding this increased demand on the Station's facilities, progress was made in the development program for the Station's experimental-forest system, and marked progress was made in current studies under the six major Silvics projects: Regeneration, Fire, Naval Stores, Silviculture, Fundamental Studies, and Mensuration.

The great expansion of planting under ECW and the keen, though gradually awakened, interest in private forestry, have resulted in a very greatly increased demand for results obtained in our seeding and planting studies. These forestation problems are complicated by their marked expansion into large-scale operations. For example, the introduction of modern forced-draft kilns necessary to extract seed from cones in the quantities needed for existing planting programs has resulted in seed with a higher moisture content than that in seed extracted at air temperature or in the less efficiently heated, slower, home-made kilns previously in common use, and this high moisture content has in turn resulted in unprecedented difficulty in storing seed, even for 2 or 3 months. The need for expanding nursery and planting practices to the hardwoods is also becoming more evident.

The troublesome problems of fire have continued to command much attention. For a region where frequent burning has been the custom ever since the first settlements were made and yet where the second-growth forests with their woodworking industries still outrank all other industries except agriculture in economic importance, it is not strange that there should be questions about the actual effects produced by fire. Damage appraisals are particularly difficult, because the net result is frequently an algebraic sum of pluses and minuses. The biggest loss, the killing or stunting of forest reproduction in the seedling stage, is not readily observed, yet it largely accounts for the present understocked stands and contributes to higher production costs. In the naval-stores belt, for example, is found an average of 15 turpentined trees per acre, whereas it should be practicable to work 3 or 4 times that number per acre. Also, the development of national forests and an increased interest of State and private forestry in the South have greatly increased the demand for basic studies on fire behavior. The Station has attempted to meet these important problems by expanding its fire-research activities even at some sacrifice to other projects.

As a result of decreased world demand and increased carry-over stocks, the naval-stores industry at the beginning of the 1936 season faced serious overproduction and a demoralized market. Through a conservation program of the AAA, prices have considerably improved. The Station assisted materially in drawing up the original naval-stores program. The program proposed for 1937, which was unanimously endorsed by the Gum Turpentine Farmers Association, includes among its main features conservative chipping practices, as developed by the Station, and fire protection. The factors which evolved such a program have focused attention on the needs for research if there is to be any permanent improvement of the present unfavorable naval-stores situation. In addition to research to develop new uses and markets for turpentine and rosin--the field of the Bureau of Chemistry and Soils--investigations are needed on the possibilities of more efficient producing methods, such as: (1) working more trees per acre, (2) working only large trees, (3) utilizing only the higher-yielding soils and sites, (4) working trees that are apparently high gum-yielding, (5) use of more efficient chipping methods and (6) a more efficient system of management for turpentine orchards to reduce costs and fixed charges.

There is an increasing demand for information on thinning, pruning, an stand-improvement in general, as well as on the basis for formulating markin rules. Much of this demand comes from owners of farm woodlots or from extension foresters and Federal agencies interested in woods of that type. The farmer is in a good position to take advantage of rather intensive methods o stand-improvement and for that reason requires recommendations in a somewhat different form from those applicable to large-scale operations. An attempt is being made to meet more adequately the demands for information in the field of silviculture from current measurements and from studies of the history of the effects of various practices on tree- and stand-development rather than from measurements from permanent sample-plots, which can yield basic data only after a large number of plots has been installed and measure over a relatively long period of time. Permanent sample plots are very useful and, in certain cases, indispensable, but there is need for getting certain information immediately or in as short a time as possible. In the Southeast, for example, there are increasingly extensive areas of dense second-growth slash pine coming in on areas protected from fire for which th question of when and how to thin to promote the growth of various products must be answered shortly if the thinnings are to accomplish the most good.

The interest evinced in the rapid growth of young slash pine either in plantations or when seeded on protected areas, together with its suitability for paper pulp and its superiority as a naval-stores tree, has focused attention on the need for reliable data on thinning, yields of cordwood, and grow and yield in general. Likewise, a demand exists for better figures on growt and yield of all the pine and many of the hardwood species of the South.

In the following paragraphs the salient accomplishments under each of the current projects or fields of work are given, followed by the plans for 1937. It is not possible to work on every important problem, but an attempt is being made to make the research work in forest management yield results that are timely as well as of permanent value. Some fields of work, such as hardwood silviculture and genetics, are not covered, even though their needs are extremely urgent and even though they promise valuable returns, because adequate funds for such studies are lacking.

REGENERATION

Accomplishments during 1936

1. A study of the effect of the geographic source of seed of southern pine on the trees and plantings obtained was started. A great number of cooperators contributed seed from the 1935 seed crop, and 336 samples representing 40 sources from Pennsylvania and New Jersey to Florida and Texas, about equally distributed among the four species of southern pine, were sent in the spring of 1936 to 14 cooperating nurseries scattered throughout this same territory. The Station grew stock from each of these 40 sources, and field plantations of these have been established on the Palustris Experimental Forest in central Louisiana; also, plans are in progress for similar plantations near most (if not all) of the 14 cooperating nurseries mentioned above.

2. Progress was made in developing a simple index to cone maturity. It was found that the specific gravity of freshly picked cones is high and fairly constant for a long period prior to maturity, but begins to drop rapidly about the time the cones become mature enough to open. This study indicates that cones should not be picked until they are ripe enough to float in water immediately after removal from the tree.

3. A study of overwinter storage of longleaf pine seed was begun. Observations during the first month showed considerable deterioration in moist, dewinged seed stored in closed containers at room temperature. The effectiveness of cold storage of southern pine seed in sealed glass containers for 4 and 5 years was shown conclusively.

4. An effective system of "service" germination tests of the southern pine nurseries of the national forests of the South was inaugurated, including adequate specifications for sampling seed-lots weighing one ton or more each.

5. The roots of nursery-grown longleaf and slash pine were found capable of enduring far longer exposure to the air (20 to 80 minutes) than has been thought, depending on amount of sunlight and on the species. Pruning longleaf roots shorter than 6 inches and slash roots shorter than 7 (and especially where either is shorter than 4) reduced survival. Setting seedlings 1/2-inch or more too deep while planting reduced survival somewhat, and reduced considerably the thriftiness of longleaf pine; setting slash any higher than it grew in the nursery, and longleaf any more than 1/2-inch high, resulted in heavy mortality. Stripping of rootlets from the main roots proved among the most serious of the common injuries to planting stock. Storage of 2 weeks or more in heeling-in beds in the field caused irregular but large decreases in survival, and storage in tubs of water for 7 days or more resulted in very high losses.

6. It was discovered that active root growth took place during the period of midwinter when the roots were hitherto thought to be dormant. This has a direct bearing on the technic of lifting, shipping, and planting; points to the undesirability of prolonged storage of stock between lifting

and planting; and may explain the heavy mortality in plantations establishe just before a freeze.

7. In drill-sown beds, with drills 6 inches apart, the optimum density for pine seedlings at the Stuart Nursery (north-central Louisiana) was found to be 18 per linear foot for longleaf and 22 for slash and shortleaf.

8. Shading was found to be nonessential to the production of high-quality planting stock, although it reduced conspicuously the temperature at the surface of the soil and the evaporation rate.

9. Root pruning of longleaf, slash, and shortleaf pine stock in the nursery during the growing season was found to have no beneficial effect upon form of seedling, number of plantable trees, or field survival.

10. The sixth annual estimate of the cone crop for southern pines was made and distributed to forest agencies throughout the South.

Plans for 1937

1. Current studies of the maturity index of cones, overwinter storag of longleaf pine seed, nursery fertilizing practice, plantation survival, and annual estimate of cone crop of southern pine will be continued.

2. The results of the first 10 years' work in approximately 20 acres of experimental plantations at Bogalusa will be analyzed and prepared for publication.

3. Seed and nursery studies will be extended to some of the principa hardwoods.

4. Studies of the effect of moisture content of seed upon resistance to heat (kiln temperature), ability to germinate, and ability to keep in storage will be expanded.

5. An attempt will be made to control germination tests more precisely.

6. Studies of mixture of species will be expanded.

7. Underplanting brush with pine will be inaugurated.

8. A study of amendments to lighten excessively heavy nursery soil will be undertaken.

9. An attempt will be made to improve the criteria of seedling quality in order to increase the accuracy of the evaluation of the results of nursery studies and the reliability of rules for grading nursery stock.

10. A nursery watering study involving cultivation will be begun.

11. A study of the site preferences of species is planned under the Fundamental Studies project.

12. Some direct-seeding work is planned under a cooperative study with the Bureau of Biological Survey.

FIRE

Accomplishments during 1936

1. The Station was represented in a western field trip and conference where fire problems and fire research as developed in the western stations were considered. The Station was also represented on a fire-control committee which met in Washington to outline a comprehensive plan of fire control.

2. Plans were prepared and the foundation laid for more objective studies in fire behavior, effects, and control.

3. Small- and large-scale experiments showed that burning longleaf stands a few months in advance of seedfall reduced the ground cover sufficiently to permit a fair catch of seedlings and yet left enough ground cover to screen the seeds from birds.

4. Slash pine saplings that survived, although severely burned, in an accidental fire, have shown a remarkable recovery in height growth and form during the second and third years following the fire.

5. A preliminary cooperative experiment with the Weather Bureau indicates that fire-weather forecasts may have value in planning protection against fires in the Deep South.

Plans for 1937

1. Current work on effects of fire will be continued but modified and directed more definitely toward appraisals of complete damage.

2. Rates of spread of fire in the common herbaceous ground cover (fuel type) will be studied.

3. Work on inflammability indexes of fuel will be started.

4. The cooperative study of forecasting fire weather will be continued.

5. The practicability of fuel-type classification and mapping for the Coastal Plain forests will be investigated.

6. The advisability of devising a fire-danger rating scheme for the South will be investigated.

7. Studies in controlled burning will be continued.

8. Rainfall-probability studies, based on Weather Bureau records, will be made.

NAVAL STORES

Accomplishments during 1936

1. Contrary to general belief, gum yields from narrow back-faces on narrow bark-bars were found to yield no more than similarly sized faces on round trees. While yields were satisfactory for back-faces separated by 2-inch bark-bars, it is believed that a 4-inch bark-bar should be recommended in general practice because of the difficulty in preventing a 2-inch bar from being cut through by the average chipper.

2. Preliminary tests indicate that the gum yield of longleaf pine may be increased as much as 45 percent by using a 1-inch height of streak followed by the application of commercial HCl to the freshened streak.

3. A study of gum losses from cups due to rain washing showed no effect from gum-saving devices or types of cup and that in all cases the loss is negligible.

4. Frequent dippings do not conserve the turpentine content of the gum as usually thought, but the practice may be desirable to prevent wastage of gum from overfull and leaking equipment. Trees of high gum-yield make higher grades of rosin.

5. As an aid to computing benefit payments and making lease appraisals, relative yield of each year's working of a face on second-growth longleaf or slash pine was determined: first year, 100 percent; second, 106 percent; third, 103 percent; fourth, 98 percent; fifth, 93 percent; sixth, 88 percent; seventh, 83 percent; eighth, 78 percent. These figures apply if the overall face-height does not exceed 10 feet.

6. Dry-facing following a severe fire is likely to be variable, and, upon resumption of chipping, necessitates jump streaks of 1 to 12 inches, in order to get immediately into live, producing wood.

7. Progress was made in analyzing all available yield data from past experiments, in order to make general gum-yield tables based on species, diameter, growth rate, face width, and year of working.

Plans for 1937

1. The effect of defoliation on gum yield will be extended to slash pine, and this phase of the fire-and-gum-yield subproject will be completed.

2. Analysis of face-burning tests will be completed and a report prepared.

3. Burning treatments will be reversed on a study of effect of frequent fires on gum yield of longleaf pine, to see if the 4- to 5-percent increase in yield due to the burning still holds.

4. A more comprehensive test stimulating gum yields by the use of reagents will be conducted, using acids and bases of varying strengths, with varying heights of preparatory streaks.

5. The comprehensive study of yield from different chipping specifications on vigorous slash pine will be continued.

6. Plans will be formulated for more fundamental work on gum yield and on methods of extraction in order to better investigate the possibility of cheaper methods of producing gum naval stores.

SILVICULTURE

Accomplishments during 1936

1. An intensive study was made of the individual growth rate of second-growth slash pine in relation to spacing and to a number of readily measured or observed tree characteristics. Charts have been prepared whereby theoretical or estimated stand tables for future periods can be constructed for any kind of thinning for any given original stand. Charts are based on the use of average spacing as a criterion for estimating the width of the crown of the average tree. Crown width, total height, and age (all taken together) are highly correlated with current growth rate, which can, therefore, be estimated when the value of these three variables is known. Current growth rate is, of course, readily converted to current diameter increment, and in this way the size of the average tree is built up period by period. The stand table merely represents an aggregate of average trees.

2. Data from 25 permanent sample plots in second-growth old-field stands of loblolly and shortleaf pines near Urania, La.--17 of which have been thinned from one to five times, and 8 of which are unthinned control plots--were tabulated and summarized with particular emphasis on pulpwood yields. This summary and a brief account of the indicated pulpwood growth and mortality figures were issued as an Occasional Paper. One of the chief points brought out is that, starting at about 20 years, on all but the poor sites, a heavy thinning that removed about one-half of the entire pulpwood volume would yield at least 10 cords per acre and still leave the best trees for possible increased growth and at least one more good cut of pulpwood before the final harvest of sawlogs or other relatively high quality products.

3. A comprehensive thinning experiment in a 42-year-old stand of old-field loblolly and shortleaf pine was established on the Crossett Experimental Forest.

4. A thinning and pruning experiment in very young old-field loblolly pine was established near Urania, La., to test different combinations and degrees of thinning and pruning. In stands of this species and origin, pruning is likely to be of more importance than thinning.

5. A comprehensive large-scale pruning experiment involving 1,303 open-grown longleaf pines between 2.6 and 8.5 inches in diameter was established at McNeill, Miss., early in 1936. The experiment had two main objectives: (1) to study methods, tools, and labor requirements, and (2) to study the effects of pruning on rate of growth and on the technical quality and value of the wood in the pruned stand. The results of the study of methods, tools, and labor requirements have been prepared for publication. Hand saws with relatively short (14-inch), stiff, slightly curved blades with 5½ to 8 relatively long and narrow teeth per inch were found most satisfactory. The better of two pole saws tested, and the one found to be in general the most satisfactory tool for pruning the smaller to medium-sized trees (from 7 or 8 to 17 feet), had a stiffer, more rigidly attached blade, 16 inches long with 7 teeth per inch that cut only on the draw stroke.

6. An extensive stand-improvement experiment was established on the Palustris Experimental Forest, involving comparison of the effects of five degrees of intensity of thinning in freeing young pines from worthless competing hardwoods. Costs of labor and equipment have been kept separately for each of four experimental units in each of the five treatments.

7. Extensive tests of methods designed to effect the permanent release of small longleaf pines less than about 5 feet high from scrub oak and other small worthless hardwoods ranging from about 1 to 6 inches in diameter were made during the year, but none were successful. These small hardwoods generally sprout prolifically after the main crown has been killed, and the sprouts usually do more damage to nearby small pine seedlings than the original tree. The tests were made, therefore, in the hope of finding a method that would either eliminate entirely the sprouting or permanently dispose of the first crop of sprouts and prevent resprouting. Various methods of cutting, girdling, poisoning, and burning--alone and in combination--were tried at different seasons.

8. The annual reexamination for mortality on two large stand-improvement plots in a shortleaf-loblolly-hardwood stand near Urania, La., was made, and the results of previous inspections were confirmed: the mortality in pines of all sizes is nearly twice as great in the check areas as where large undesirable hardwoods were deadened and where the stand was thinned for pulpwood.

9. A combined pulpwood and sawlog cutting in the loblolly-hardwoods type to stimulate advanced reproduction and improve the stand condition silviculturally was initiated and completed during the year at Urania, La. Computations made to determine the commercial feasibility of such work showed that the sawlog operation just paid its way, but the pulpwood operation failed to show a profit. Silviculturally, the cutting was very successful, and with several obvious improvements in operation it is believed that such work can be conducted at no loss or even at a profit.

10. A study of stand conditions following the cutting of pulpwood on commercial operations throughout the southern pine belt was initiated during the year.

11. Longleaf pine cones gathered in south Mississippi produced on the average 84 sound seeds, a value considerably below that usually used when computing seed production on the basis of cone count.

12. An investigation in Louisiana revealed that the usual method of estimating the longleaf-pine cone-crop, by counting green cones on standing trees, showed only two-thirds of the actual cone production.

13. Seedbed studies indicate that light, grassy ground cover interferes least with the reaching of mineral soil by the seeds; oak litter ranks next; and heavy pine litter, as found under dense second-growth stands, interferes most of all. Once the seed has reached the soil, however, the chances of loss due to birds and rodents with the three types of litter are in reverse order. Further studies revealed that the type of litter, degree of decomposition, and ease of contact with mineral soil were all very significant factors in the germination of longleaf and slash pine seed.

14. The destruction of potential seed crops was indicated by a study of longleaf cones during their first year of development. Despite the formation of many young seed-cones, only 25 percent of the conelets remained on the tree at the end of the first year. That this percentage will be reduced still further is certain. Insects are the chief destructive agency.

15. Remeasurements of the slash pine thinning plot at Cogdell, Ga., 2 years after thinning, indicated that at the age of 12 years 200, 300, or 400 trees per acre could be selected for the residual stand with no impairment of growth per tree. That is, the average growing capacity per tree of the best 400 trees was not much inferior to that of the best 200 trees per acre. This is of considerable significance in this region where it is desired to delay heavy thinning as long as practicable in order to obtain pulpwood-sized material from the intermediate cuttings.

16. A stand-improvement and local drainage experiment was established on the Olustee Experimental Forest in northeastern Florida.

Plans for 1937

1. Current experiments in thinning, pruning, and silvicultural improvement of stands will be continued.

2. A series of harvest cuttings is to be initiated on the Crossett Experimental Forest. These cuttings will include clear-cutting in strips, shelterwood strips, and uniform and selection cuttings. Growth, reproduction, species composition, and logging damage are to be studied.

3. A semicommercial harvest cutting is planned for the new San Jacinto Experimental Forest in Texas. This cutting will demonstrate the possibilities of various kinds of management in the shortleaf loblolly hardwoods type and will contrast production of pulpwood as a primary crop with the production of pulpwood when integrated with that of other forest products.

4. The study of stand conditions on old pulpwood cuttings should be completed during the year.

FUNDAMENTAL STUDIES

Accomplishments during 1936

1. The intensive work on the competition-density study at Bogalusa, La., was completed. The results show that both density of stocking and ground cover influence the rate of growth of longleaf pine seedlings. The greatest growth occurred on the plots denuded of all vegetation. The results definitely indicate that denudation of the ground in the vicinity of the longleaf pine seedlings expedites their emergence from the grass stage. The results can be summarized as follows:

Density[1] per acre	Increase in height growth during a 3-year period (1932-34)		
	Denuded areas	Grass areas	Grass-scrub-oak area
	Percent	Percent	Percent
1,000	2,007	627	
5,000	1,685	383	80
10,000	621	275	
15,000	506	208	
25,000	457	123	
50,000	223	91	
100,000	158	82	

---

[1] All longleaf seedlings were in the grass stage (about 1 inch in height) and of the same relative size when the plots were established in 1932.

2. A study was initiated to determine the size and distribution of roots of longleaf pine seedlings and of associated grasses and herbs.

3. An exploratory study in the water requirements of longleaf and slash pine seedlings was completed. The tentative results obtained indicate that both longleaf and slash pine will grow in either dry or wet soils, but best growth development and the greatest dry weight of seedlings were obtained under moist soil conditions. These results have a practical application in nursery practice and indicate that the site requirements for slash pine may differ little from those of longleaf, contrary to general belief.

4. A study of the effect of deficiency of nutrients on the growth of longleaf pine seedlings was initiated on the Harrison Experimental Forest under greenhouse conditions. The results show that the best growth occurred in the cultures with all the nutrients and in the one lacking phosphorus. The cultures lacking either nitrogen, magnesium, or sulphur showed intermediate growth, and the poorest growth occurred in the cultures lacking potassium and iron. Of interest is the fact that the lack of certain of these salts showed definite and recognizable symptoms. The results, which seemed to indicate that potassium and not nitrogen may be the most essential

element for growth of longleaf pine, not only have definite value in nursery work but also have an important bearing on the effect of fire on the soil.

5. Some results from the studies on the effects of fire on soil were published during the past year. The field work for this phase of the fire-and-soils studies was practically completed. It was reported last year that soils subjected to frequent fires were found to be less acid and contained a higher percentage of replaceable calcium and total nitrogen. Two outstanding differences found between soils of burned and unburned areas this past year were in penetrability and volume weight. The soils from which fire had been excluded were consistently more penetrable and lighter in weight per unit volume (reflecting greater pore space) than the soils from burned areas. Typical soils from burned areas, even when sandy in texture, showed small, irregular accumulations of organic material, caused by surface movement of rain water. These accumulations are related to the high degree of compactness of the soil, which is caused by exposure and lack of faunal activity, following removal by fire of the ground cover and pine litter. Therefore, the marked differences in penetrability and porosity between burned and unburned soils can be attributed chiefly to differences in the soil fauna population.

6. One of the most important phases of the work on fire and soils is the determination of the trend of soil moisture in burned and unburned plots in the field. Significant differences in moisture content have been found for all kinds of weather, ranging from very wet to very dry. Even in openings on unburned areas the soil is more moist than that of burned areas. In openings a dense interwoven mat of perennial grasses influences the water relations of the soil surface, much as does the forest floor of a closed stand.

7. A study of the humus layer under longleaf pine forests was made, and the results were published in Florida Agricultural Experiment Station Bulletin No. 302 (September 1936).

8. A study of soil temperatures during forest fires indicated that the heat from the forest fires which occur normally in the longleaf pine region is insufficient to deteriorate the soil.

Plans for 1937

1. During 1937 it is planned to complete the field work on the fire-and-soils studies.

2. The study of factors affecting the growth of longleaf pine seedlings will be continued.

3. A study will be initiated to determine the site preferences of species. Results of this study will be particularly useful in determining planting programs.

MENSURATION

Accomplishments during 1936

1. Progress was made in the development and adaptation of statistical methods, particularly in the design of experiments applicable to the studies on naval stores, forestation, and thinning.

2. A comprehensive study of the effect of turpentining on increment was initiated.

3. Sixteen of the red gum growth plots established 5 years ago were remeasured.

Plans for 1937

1. Existing volume-table and converting-factor data for the southern pines and hardwoods will be assembled for publication.

2. Existing data will be analyzed and plans made to strengthen the system of sample plots to obtain information on growth and mortality.

3. The practicability of getting improved slash-pine growth and yield figures will be investigated.

4. The study on turpentining and growth will be continued.

FOREST INFLUENCES

Studies on forest influences are being conducted under two lines of investigation, namely, watershed improvement and the water cycle. The first includes studies to develop effective and practicable methods of rehabilitating watershed areas and of safeguarding watershed values through forestry measures. These are primarily studies in technic. The water-cycle project includes studies on the influence of forest and plant cover on the water cycle or, more specifically, the relation between (1) alteration and improvement treatments of the forest and (2) run-off, consumptive use, evaporation, and groundwater storage. As described in previous annual reports, most of the studies undertaken were under the watershed-improvement project and dealt mainly with the problems of rehabilitating eroded, abandoned farmlands in the Mississippi loessal region and adjacent portions of the Upper Coastal Plain.

Accomplishments during 1936

Major accomplishments during 1936 were the inauguration of water-cycle studies in the Ouachita Mountain region of west-central Arkansas and the establishment of a number of new watershed-improvement studies near Holly Springs, Miss., to round out the program at this branch station. The following points are worthy of mention:

1. Studies were initiated on the new Irons Fork Experimental Forest located within the Ouachita National Forest, in Polk County, Ark. The general object of these studies is to evaluate the effects of forest-management practices and watershed-improvement measures on stream behavior, with a view to developing methods of deriving maximum watershed protection from these mountain forests.

Preliminary to more intensive studies, four watershed units, each about 150 acres in area and comprising the headwaters of Hoover and Nesbitt Creeks, have been selected for study. Stream-gaging stations, equipped with automatic water-level recorders, were set up to measure the flow from each unit, and 75 standard rain gages and 2 recording gages have been distributed over the 4 watersheds to furnish a record of rainfall. Thirty-two sets of paired run-off plots, each plot 4 by 18 feet in projectional dimension, have been installed at two altitudinal zones within the four watersheds and in four principal types of cover: (1) mature shortleaf pine and hardwood forest with tree reproduction-understory, (2) mature forest only, (3) tree reproduction only, and (4) stand openings (herbaceous vegetation only). Together with streamflow records, the data from these installations will indicate (1) whether actual surface run-off is a major factor in flood discharges and, if so, where such run-off originates; (2) whether alteration or improvement of the cover types will effect a reduction in peak flows.

2. At Holly Springs a forest-litter study, started in 1932, was completed. The purpose of this study was to determine the effects of applying forest litter to a badly eroded, compact subsoil on infiltration and run-off. The data showed that forest litter, even though the soil was very impermeable to rainfall prior to litter application, decreased soil erosion to negligible proportions and reduced surface run-off to less than half. Reductions in run-off were largely due to increased absorption of rainfall by the litter-covered soil. Sampling of the soils at termination of the study revealed that litter-covered soils were significantly lighter in weight than barren soils and averaged approximately 7 percent less per unit of volume. This experiment reveals why brush and litter covers are proving so effective as supplemental aids to the revegetation of eroding areas, and demonstrates that surface applications of such material are capable of amending the physical structure of the underlying soil within a very short time--in this case, within three years.

3. Measurement of soil and water losses from two small gullies on which control measures were inaugurated early in 1935 were continued during 1936. Although a complete cover of vegetation has not yet become established, soil losses have dropped to practically nothing and run-off has been greatly reduced.

4. Some exploratory work was done in connection with inaugurating a study at Holly Springs to investigate rainfall infiltration through representative forest soils, and moisture retention by that part of the soil profile comprising the root zone. The plan calls for direct measurement of surface run-off from specially constructed plots and determination of ground moisture throughout the underlying root zone by soil-sampling methods. By relating such observations to rainfall data from individual storms, it should be possible to separate rainfall into (1) the part running off, (2) the portion retained by the root zone and hence subject to evapo-transpirational draft, and

(3) the fraction penetrating beyond reach of roots. Several sample installations have been made; and owing to great uniformity of the soil profile, the relatively great depth to the water table, and the permeable character of the soils, it appears that the methods outlined will yield pertinent data.

5. Under the watershed-improvement project some 53,200 trees were planted during 1936 on 223 plots located on various planting tracts within the Holly Springs National Forest. These studies deal with the problems of establishing three important species used in erosion control (black locust, shortleaf pine, and loblolly pine) on impoverished, abandoned farmlands. Earlier studies under this project involved chiefly species trials and studies of technic for controlling gullies. Two of the 1936 studies, requiring the planting of 43,200 shortleaf and loblolly seedlings, were establishe to determine methods of obtaining satisfactory survival on old-field plantin sites. Preliminary indications from one season's data are that (1) poor quality of the planting site is the major cause for poor survival, and (2) some of the site-improvement treatments, notably soil stirring, are effecti in decreasing mortality.

Approximately 10,000 black locust seedlings were planted in a group of six studies, one of which was designed to test the effect of site-improvemen measures on survival and early growth. Other studies test the influence of such factors as planting stock, mode of storage, root form, and root and top pruning.

6. A new study was started to compare more than 40 treatments designe to quickly establish a protective vegetative cover on road-banks. Two types of planting were employed: (1) the usual sodding to Bermuda grass; and (2) direct sowings of a mixture of seed of Bermuda grass, carpet grass, Johnson grass, Abruzzi rye, oats, cowpeas, three varieties of lespedeza, and crotalaria (C. spectabilis). In addition, the treatments include in various combinations such measures as pre-scarification of the slope, contour trenching, application of top soil and fertilizer, staked brush covers, and planting of a preliminary winter cover crop. The study is divided into a fall and a spring phase. The fall tests are concerned with the problem of protecting banks constructed late in the growing season where it is impossible for ordinary plantings to become fully established before winter sets in. This gives rise to the question of what to plant, whether to defer planting until spring, what protection to provide in lieu of planting, etc. One promising variation under test in the fall phase is the sowing of a winter cover-crop mixture (burr clover, hairy vetch, Austrian winter peas, oats, rye, and barley). This treatment is being applied contemporaneously with regular fall soddings and sowings as well as on plots reserved for spring plantings in 1937.

Plans for 1937

1. Plans for 1937 call for greater emphasis on studies of relationships between forests and floods and for a well oriented attack on basic water-cycle problems. The present Ouachita studies will be augmented by a study of shallow groundwater drainage to determine what part this type of run-off plays after storms in contributing to peak flows of streams. Other

urgent studies which will probably have to be deferred until later include: (1) a study of the moisture-retaining capacity of typical litter and ground-cover types; (2) a study of rainfall interception by tree crowns; and (3) a study of field-moisture capacities of representative root-zone profiles on drained slopes. Also needed are watershed-improvement studies testing the effectiveness of forest-engineering measures for protecting stream channels and for temporarily storing surface and ground waters.

2. In north Mississippi, it is planned to start a rainfall-penetration investigation. Other important studies which are projected include: (1) a ground-water study correlating clearing of land with the flow of perennial springs, and (2) a study comparing stormflow rates and quantities from reforested gullies with those from unplanted gullies. Field establishment of the road-bank study will be completed with the spring plantings in May 1937, and extensive confirmatory trials of the most promising treatments from the fall tests will be made late in 1937 on forest road-banks. Another study needed to supplement that now under way is one to compare rate of establishment of the more promising erosion-control species, including vines, shrubs, grasses, and herbaceous plants, on road fills and back slopes. Although more than 40 such species are available in the Station's territory, very few have actually been used for bank fixation, and there have been no formal tests to indicate the comparative effectiveness of each species.

FOREST ECONOMICS

FINANCIAL ASPECTS OF PRIVATE FORESTRY

The purpose of studying the financial aspects of forestry is to determine and demonstrate profitable methods of management of southern forests for the continuous production of commercially valuable forest products and for the highest economic use of the land.

During 1936, because of the curtailment of emergency funds, investigations were limited to the loblolly and shortleaf pine region and for the most part were concentrated on the Crossett Experimental Forest and surrounding area in southeastern Arkansas. The areas studied are accessible to owners of forest land as demonstrations of approved forestry practices. Good commercial practices have been followed so that the results obtained are practical and usable. Although the returns and costs may not be directly applicable to other forest properties, the principles of forest management that have been developed apply to an extensive region.

The Station's studies are showing definitely the financial possibilities of second growth stands of loblolly and shortleaf pine and hardwoods. Such typical stands in southeastern Arkansas average about 3,000 feet b.m. (International 1/4-inch scale) of pine sawtimber (14 inches and more d.b.h.) and 1,000 feet of rather poor quality hardwoods (14 inches and more d.b.h.) per acre, besides considerable young growth. Studies have shown that these stands under sustained-yield management may yield at present an annual gross income of from $1.00 to $1.75 per acre, depending on the management, growth, and economic conditions. Pine in these stands was growing in volume at a rate of about 7 percent compounded annually. Average stands of 3,000 feet b.m. of pine per acre will during a 10-year period grow into stands containing 5,900 feet per acre or will grow at the average rate for the period of 290 feet per acre per year. Since even these stands of 5,900 feet per acre are understocked, the cut should not take all of the growth but should be limited to less than the growth, for example, to about 2,000 feet, leaving 900 feet for addition to the growing stock. Even this periodic cut is equivalent to an annual yield of 200 feet b.m. (30 cubic feet) per acre per year. In this same second-growth timber the yield of pulpwood in cubic feet which can be cut from tops, thinnings, or improvement cuttings, at the end of the 10-year period, equals about two-thirds of the cubic-foot volume of the sawtimber cut. In such a case, with an annual yield of 30 cubic feet of sawtimber per acre, the additional yield of pulpwood is 20 cubic feet of solid wood or 0.27 cord of stacked wood with bark per acre per year.

At present, pine sawtimber stumpage ranges in value from $3 to $9 per M feet b.m. (2 to 6 cents per cubic foot), depending on size, quality and location. At an average value of $6 per M board feet, the annual yield of 200 feet has a stumpage value of $1.20. The pulpwood yield of 20 cubic feet per acre per year with a stumpage value of 1 cent per cubic foot (75 cents per standard cord of 128 cubic feet) has a value of 20 cents. The value of the annual yield of hardwoods is estimated at 15 cents per acre. Under these conditions, the gross income from total stumpage is $1.55 per acre per year. The total present cost of forest management including taxes, fire protection, technical services of a forester and assistants, general administration, etc., is estimated at from 20 to 30 cents per acre per year.

After several cutting cycles under good management these second-growth stands will be much better stocked with higher quality trees, and yields should be correspondingly better both in volume and in quality. Increment measurements in a few unusually well-stocked second-growth stands indicate that the yield recorded above can be doubled after stands are built up. Probably costs will increase also, but not in the same proportion, and it is estimated that they will range from 30 to 50 cents per acre per year.

Results of the Financial Aspects investigations show that the following practices can be recommended to forest landowners in the loblolly and shortleaf pine region:

1. Fire control that will limit the average area burned annually to less than 1 percent of the total area protected.

2. Thinning for pulpwood in dense young stands of old-field and second-growth timber; reserving the best-formed trees, properly spaced, as basic growing stock for future development into high-quality sawtimber.

3. Improvement cutting for pulpwood or cordwood in second-growth stands which are unmerchantable for sawlogs; gradual removal from all merchantable diameter-classes of those trees that will not develop into high-quality material, thus saving the better and more vigorous trees.

4. Periodic selective cutting at short intervals (3 to 10 years) in sawtimber stands, with each cut removing less volume than will be replaced by growth before the next cut, thus automatically increasing the productivity of stands until the growing stock is ample for maximum growth. The cut should be limited as far as the felling budget will permit to trees financially mature because of size, poor condition, or low capacity for growth, in order to shift growth from trees of poor form and vigor to better trees. Within the limits of economic feasibility, vigorous high-quality trees of the larger sizes should be included in the reserve stand so that as much as possible of the productivity of the site can be devoted to growth of sawtimber of high quality and value.

5. Integrated utilization to the greatest extent consistent with available markets, providing for the highest and most profitable use of each tree and each portion of each tree. Pulpwood and cordwood should generally be produced from tops of sawtimber trees and from trees below 14 inches d.b.h. removed as thinnings and improvement cuttings and not from those portions of trees suitable for sawlogs.

Accomplishments during 1936

1. Inventory of growing stock on the Crossett Experimental Forest.

On the Crossett Experimental Forest of 1,680 acres of merchantable second-growth loblolly and shortleaf pine and hardwoods, located in southeastern Arkansas, an area of 1,000 acres has been set aside to determine and demonstrate profitable methods of sustained-yield management, when stands are cut selectively with various cutting cycles. On this tract accurate records of all yields, incomes, and costs are being kept. The remainder of the forest has been dedicated to permanent sample plots for detailed studies, to administrative sites, and to other special purposes. A 20-percent strip survey, determination of diameter growth, and measurements for local volume tables have been made. Stand tables and stock tables of volumes of sawtimber trees and of cordwood in tops and in trees below sawtimber size have been compiled for each 40-acre tract, for each forest type and condition, for the 1,000-acre area set aside for sustained-yield management, and for the forest as a whole. The volumes per acre of pine range from 1,300 board feet (International 1/4-inch rule) for the poorest 40-acre unit to 9,000 board feet on the best. The average stand per acre for the forest as a whole is about 4,100 feet of pine and 860 feet of hardwoods.

2. Growth study and timber-management technic.

With the stand and stock tables and diameter-growth data from the Crossett Experimental Forest as a basis, the technic of predicting future volume growth is being studied. Current annual increment for each forest type and condition, for the sustained-yield tract and for the whole forest, was determined during 1936. The current annual volume growth per acre for the forest as a whole is 280 board feet of pine and 30 feet of hardwoods. It is planned to try out various methods of determining current volume growth for stands on this forest, in an effort to determine a simple but accurate method which forest owners can apply readily.

Not only is it necessary to determine volume growth in predicting yields of forests and in making plans for management but it is equally important to determine quality or value growth. A study of form, taper, and quality of pine stems is being made in order to correlate value and quality growth with volume growth or increment.

3. Selective logging in second-growth loblolly and shortleaf pine and hardwoods.

Field work has been completed for a selective-logging study to determine the relative costs of light cuts versus heavy cuts and to determine the effects of tree size on logging costs. Results show that with truck transportation the costs per M feet of logging 500 board feet per acre were practically the same as when 4,000 board feet per acre were removed. The total cost of felling, bucking, loading, and hauling (average haul of 4 miles), without an allowance for profit to the contractor, averaged about $3 per M board feet (International 1/4-inch rule) for the total 850 M board feet removed. The costs per M board feet decreased with increase in tree size and were $3.41 per M for 12-inch trees, $2.59 per M for 16-inch trees, $2.19 per M for 20-inch trees, and $2.12 per M for 24-inch trees. This study points out the practical feasibility of frequent light cuts, which are essential in obtaining sustained yields from this type of forest. The costs obtained in this study have been used already as the basis for certain contract logging prices; and several large lumber companies in the loblolly and shortleaf pine region have recently adopted a system of light and frequent cutting in managing their forest properties.

During 1936, a second selective-logging study was made at Crossett using crawler tractors of several sizes instead of trucks. Both ground-skidding and hauling with an arch were thoroughly tested. Supplementary studies at several other locations where crawler tractors were already used by lumber companies were made for comparison with results of the Crossett study. These results, now being compiled, indicate that the economic length of haul for tractors is rather limited and that the cost per M feet for large logs is much less than for small logs.

4. Stumpage values of loblolly and shortleaf pine utilized for lumber.

The pine and hardwood logs cut in the selective-logging study at Crossett were put through the mill; and the grade, volume, and value of lumber for each log and tree were recorded. Costs of milling and selling for logs and trees of different sizes were also obtained. Stumpage values by diameter-classes were then computed by deducting logging, milling, and selling costs from sale values of lumber produced. Results by tree-sizes, using 1935 labor costs and lumber sales-prices, are summarized in the following table:

D.B.H.	Green-chain volume per tree	Lumber sales value per tree	Cost of milling per tree	Cost of logging and milling per tree	Value remaining per tree for stumpage and profit	Value remaining per M feet for stumpage and profit
Inches	Board feet			Dollars		
12	77	1.90	1.27	1.79	.11	1.43
14	127	3.04	1.96	2.63	.41	3.23
16	201	4.74	2.93	3.79	.95	4.73
18	298	7.10	4.14	5.23	1.87	6.28
20	410	10.07	5.48	6.79	3.28	8.00
22	533	13.68	6.89	8.41	5.27	9.91
24	665	17.73	8.40	10.12	7.61	11.42
26	805	21.97	9.90	11.84	10.13	12.56

This table shows very clearly the higher stumpage and lumber values of the larger trees, and illustrates the financial advantage of building up the growing stock of managed forests by conserving the larger diameter-classes.

5. Costs and returns in producing pulpwood from second-growth loblolly and shortleaf pine.

During 1936, improvement cuttings for pulpwood were made on eight 40-acre units on the Crossett Experimental Forest. Pine trees, which, because of defect, crook, or limbiness, will not pay for further growth, or which were interfering with growth of more valuable trees, were removed. Trees of sawlog size were not cut. In these typical second-growth stands 1.3 cords of pulpwood per acre were removed, yielding a stumpage value of 32 cents per cord after all cutting and hauling charges were paid. (Since the date of this study the price paid for pulpwood has increased, and further increases are almost certain.) This is derived by subtracting the cost of marking (7 cents), of cutting ($1.11), and of hauling ($1.50) from the delivery price ($3.00). Such cuttings are yielding an income with which to meet taxes. They are also shifting growth from trees of poor vigor and form to trees of better quality, thus absorbing future cuts of higher quality and greater value.

In connection with the selective-logging study at Crossett, it was demonstrated that pulpwood, cut from tops of second-growth pine sawtimber following logging, was acceptable by pulp mills and that the difference between (1) the costs of cutting and hauling and (2) the delivery price left a fair margin for profit and stumpage. Not only does this yield a profit but it also reduces the fire risk by reducing the amount of slash left on the ground. In typical second-growth stands a yield of about one-half cord of topwood per M board feet of sawlogs was obtained. Trees above 24 inches in diameter contain very little pulpwood because the large limbs of the top make pulpwood production unprofitable. The relationship between cubic feet in tops usable for pulpwood and cubic feet in sawlogs varies with size of tree as shown in the following table:

Merchantable Volumes Per Tree

D.B.H.	Sawlog Material	Pulpwood volume in the top	Total	Proportionate volume of sawlog material
Inches	Cubic feet[1]			Percent
12	17.0	6.8	23.8	71.4
14	24.1	7.7	31.8	75.8
16	34.9	8.3	43.2	80.8
18	47.7	8.8	56.5	84.4
20	62.7	8.8	71.5	87.7
22	79.3	8.1	87.4	90.7
24	97.0	6.4	103.4	93.8
26	114.9	4.0	118.9	96.6
28	133.0	.9	133.9	99.3
30	151.0	.0	151.0	100.0

[1] Inside bark.

Plans for 1937

Shortleaf-loblolly pine region. During 1937, the following studies will be in progress on the 1,000-acre sustained-yield tract of the Crossett Experimental Forest, as representative of the loblolly and shortleaf pine and hardwood region:

1. Improvement cuttings for pulpwood on those areas not yet covered. Yields, incomes, and costs will be obtained by tree sizes, and totals will be kept by 40-acre units.

2. Improvement cuttings for chemical hardwood. Here also yields, incomes, and costs will be obtained by tree sizes,and totals will be kept by 40-acre units.

3. Thinning of young old-field pine stands for pulpwood. Yields, incomes, and costs will be kept by tree sizes and the totals by definite areas.

4. Sawtimber cutting of selected 40-acre units, in order to determine advantages and disadvantages of 3-, 6-, and 10-year cutting cycles. The cut will be held below growth on each area so as to build up the growing stock both in volume and in quality. All trees to be cut will be marked by a technician, and a detailed inventory of trees to be cut and of the stand at the time of marking will be taken. Costs of marking and of the inventory will be kept. Inventories will be taken at the end of each cutting cycle, and the current annual increment and increase in quality and value of the growing stock between cuts will be determined from these inventories. At the time of the cut, yields and incomes from sawlogs, pulpwood, and chemical-wood, and costs of logging, will be kept by tree-sizes and by operations. Total yields, incomes, and costs will be compiled and recorded for each 40-acre unit.

5. The technic of determining growth in volume and value, of marking timber so as to improve quality and increase the yield, and of regulating the cut, will be studied.

Other forest regions of the South. During 1935, Financial Aspects studies were carried on in the slash and longleaf pine region as well as in the loblolly and shortleaf pine region. Curtailment of funds in 1936 made it necessary to discontinue the work in the longleaf and slash pine region, but a progress report, "An investigation of pulpwood production from round and turpentined longleaf pine," was issued in December as Occasional Paper No. 58. Unless additional funds are available, no Financial Aspects investigations will be undertaken in 1937 outside of the loblolly and shortleaf pine region.

NEW PUBLIC DOMAIN

The manuscript entitled "Forest land tax delinquency in Arkansas" was further revised, and the Arkansas Agricultural Experiment Station plans to publish it early in 1937. A report, "Land ownership in Survey Unit #1, Florida," was issued as Occasional Paper No. 56 on December 22, 1936. Two office reports, "Land taxation and tax delinquency in Survey Unit #1, Florida" and "Land ownership, taxation, and tax delinquency in Survey Unit #1, Georgia," were also prepared. These three reports are being used by the Forest Survey as a source of ownership-taxation information in its reports on these units

The study of assessed valuation, taxation, and tax delinquency in northeastern Florida showed that in general the assessed valuation per acre was highest on property owned by townspeople and farmers and lowest on property owned by lumbermen and naval-stores operators. It also showed that assessed valuations, in general, were highest on tracts of less than 100 acres. In respect to land-use classes, valuations were commonly highest on improved farm lands followed in order by land held for speculation, timbered lands, unimproved farm lands, and cut-over lands.

Tax rates ranged from 38.375 to 59.75 mills per dollar of valuation. The tax per acre was generally highest on tracts averaging 1 to 50 acres in area.

The study of tax delinquency showed that 41 percent of the region (4,047,000 acres) was in default for 3 or more years. In the rest of the State outside this unit only 32 percent of the area was in default for this same period. The East Coast counties were much more seriously involved in tax default than the other counties. The lumber counties had the least delinquency, only 20 percent of their area being in default. For the 8 counties specifically studied, the survey showed that property owned by land speculators was most prone to delinquency, followed in order by that held by "unknown" owners, naval-stores operators, lumbermen, unclassified small owners, farmers. townspeople, banks, and loan and insurance companies.

The study of land ownership, taxation, and tax delinquency in southeastern Georgia covered 6 counties: Clinch, Wayne, and Liberty Counties in the Coastal-Plain flatwoods; Coffee County, in the middle Coastal Plain; and

Dodge and Emanuel in the upper Coastal Plain. These three physico-economic sub-divisions presented very different pictures as to land ownership but more comparable relationships with respect to taxation and tax delinquency. The region of the Coast-Plain flatwoods was very largely owned by naval-stores operators, with lumbering an important secondary activity. Much of the area was held in tracts averaging 5,000 acres or more, some individual tracts running up to 100,000 acres. As in Florida, however, most of the tracts were less than 500 acres in area. The middle Coastal Plain, as represented by Coffee County, was owned to a very large extent by farmers; forest-operator holdings averaged only 8 or 9 percent of the total rural area. Most of the holdings were from 100 to 500 acres in area; very few holdings exceeded 5,000 acres. In the upper Coastal Plain as represented by Dodge and Emanuel Counties, farmers again were the large landowners, holding from 50 to 65 percent of the area. One noteworthy feature in this area was the large proportion (16 to 20 percent) of the rural area owned by banks and by loan and insurance companies. This condition appeared to represent a breakdown of private land-ownership, since most of these tracts were acquired through foreclosure of mortgages.

The study of valuation revealed that, with few exceptions, type of ownership had little or no effect on valuation per acre. For example, in the 6 counties studied, the actual variation between the average assessed valuation of improved farm lands on the one hand and cut-over forest lands on the other was only $1 to $5 per acre. This, of course, did not in any way reflect the actual differences in sale value of these types of property. Within the counties of the Coastal-Plain flatwoods the tax on timbered land and that on cut-over lands were practically identical, the variation betwee them being only a fraction of a cent per acre. Taxes averaged from 2 to 6 cents per acre. In the middle Coastal Plain the variation between the tax on timbered land and that on cut-over land was only about 1 cent per acre, and the taxes ran from 9 to 10 cents per acre. In the upper Coastal Plain there was considerably more variation between the taxes on the two classes of forest lands, cut-over lands averaging about 8 cents per acre and timber lands from 13 to 22 cents per acre. Of the total area (1,819,000 acres) approximately 17½ percent were in default for 3 or more years. Several cou ties, however, had no land in default, whereas others had between 70 and 7 percent of their area in this condition. It was impossible to determine th relationship of delinquency to ownership in Georgia, as was done in Florida, but the data on uncollected fi fas indicated the usual trend in delinquency during the depression. In every county delinquency increased rapidly, even though the actual tax levy declined in all cases. One noteworthy factor co tributing to delinquency in Georgia is the failure of the county to enforce collection of taxes by actual sale of the delinquent property, even though this is provided for by law.

During the latter part of 1936 plans were developed for a study in co-operation with various agencies of (1) forest-land taxation with particular reference to the legal aspects and incidence of drainage and levee taxes, and of (2) tax delinquency in the Yazoo Delta of Mississippi. Field work o this project will start early in 1937.

Plans for 1937 include the completion of the above study in Mississip and the extension of similar studies into other areas typical of major fores or economic regions within the territory served by the Station.

FOREST TAXATION

Almost 8 months of 1936 were spent by the Station's taxation economist, Dr. Nelson, on the National Forest Contributions study. During more than half of this time he was assisted by Mr. Craig. This study was made to help determine the effect of acquisition of national forests on the finances and fiscal condition of local governments, and to assist in devising a system of Federal contributions to local government which might be more equitable to the local unit than the present system, which is based on the distribution to the local government of 25 percent of the gross receipts from the national forests in the region involved, for the support of schools and roads, plus an additional 10 percent expended by the Secretary of Agriculture for the construction and maintenance of roads and trails within the National Forests of the state in which the revenues were derived.

Detailed studies of the economic problems (State and local finance, effect of national-forest acquisition on local finance, and of the Federal acquisition policy) were made on 10 national forests in the South located in 14 counties in 9 states. Following completion of the field work, Nelson assisted in the preparation of a report for the entire country. The southern national forests included in the study were as follows: Unaka, in Tennessee; Nantahala, in North Carolina; Francis Marion, in South Carolina; Osceola, in Florida; Black Warrior, in Alabama; DeSoto and Delta, in Mississippi; Ouachita, in Arkansas; Kisatchie, in Louisiana; and Davey Crockett, in Texas.

Preliminary investigations of the forest-tax situation were made in Mississippi, Arkansas, Florida and Texas. In each of these States, consultative service was given to the State Foresters, tax committees, legislators, and other interested individuals or groups. The Arkansas survey was more comprehensive than the others and has resulted in the initiation of a special research project by the Arkansas Planning Board.

Plans for 1937 include the continuation of cooperation by the Station, along with the administrative organization of the Forest Service, in analyzing existing tax legislation and administration, in order to assist in draw ing up sound forest tax laws for states of the South when invited to do so by their respective State Foresters.

FOREST SURVEY

The Forest Survey of the United States as authorized by the McSweeney-McNary Act of May 22, 1928, was inaugurated in the South during the latter part of 1930. It includes a nation-wide inventory of the extent, location, and condition of forest lands; the quantity, kinds, quality, and availability of the timber now standing on these lands; the rate of depletion through cutting, fire, insects, disease, and other causes; the current and probable future rate of timber growth and the productive capacity of the forest area; and the present and probable future need for forest products in the different parts of the country by all classes of consumers. It also includes an analysis of the relations of these findings to one another and to other economic factors, as a basis for the formulation of policies and principles of forest-land utilization. It involves both field inventories and the compilation of data from many sources.

The Forest Survey field work in the lower South, except for the post oak region of about 30 million acres in Texas and Oklahoma, was completed in June 1936. The area inventoried includes 215 million acres in 13 states and extends from southern South Carolina to the timbered portion of eastern Texas and Oklahoma, including the bottomland-hardwood region of the Mississippi Valley from the Gulf of Mexico to the Ohio River. The field cruise of this extensive area has been accomplished for the most part, since the fall of 1933, when emergency funds were first made available. Upon completion of the field work, seven of the field crews were transferred to the Appalachian Station.

The computation of the vast amount of data gathered by the field crews and the preparation of reports is almost as large a task as was the field work, and it will take 2 or 3 years to make the results available to the public. The computing work has progressed, however, to a point where information on certain parts of the territory surveyed is rapidly becoming available.

The progress of Survey activities to December 31, 1936, is summarized in the following table:

Progress Report of the Southern Forest Survey as of December 31, 1936

State	Survey units	Land area	Field work completed	Computing work completed	Report preparation completed	Total completed	Papers issued to date	
							Unit reports	Releases
	Number	Acres	Percent				Number	
Ala.	6	32,818,500	100	52	3	55	None	1
Ark.[1]	4	26,331,700	100	61	3	56	None	None
Fla.	4	30,983,800	100	67	27	68	None	3
Ga.	5	36,787,700	100	56	17	60	None	6
La.	5	29,078,200	100	90	20	74	None	2
Miss.	5	29,655,300	100	79	21	72	None	3
Okla.	1	4,026,200	100	20	0	45	None	None
S. C.	1	5,186,900	100	90	20	73	None	2
Tex.	2	18,515,900	100	87	25	74	None	1
Tenn.-Va.	1	1,852,400	100	100	100	100	1	1
						Other	None	4
Total	34	215,236,500	100	68	17	63	1	23

---

[1] Includes bottomland-hardwood region in Mo., 2,498,700 acres; Ky., 70,600 acres; and Tenn., 468,500 acres.

The extent to which the lower South is forested is not generally realized, and the part that these forests must inevitably play in the economic future of the South is only beginning to be appreciated. The Forest Survey has brought out the fact that, after 200 years of occupation by an agriculturally minded population, less than 30 percent of the land in the lower South is in actual cultivation and over 58 percent of it is in some stage of forest growth. Of course, the proportion of the land surface that is occupied by forest growth is not everywhere the same. For instance, in the Coastal Pine Region, which borders the Atlantic and Gulf Coasts from South Carolina to the Mississippi Delta and extends west from the Delta into east Texas, 70 percent of the 80 million acres of land is in some stage of forest growth. In the longleaf and slash pine forests of the eastern part of this region almost three-fourths of the world's rosin and turpentine are produced. Adjoining the Coastal Region and extending, in this part of the South, from the Savannah River to the post-oak region of Texas, is the loblolly-shortleaf-hardwood belt, with a land area of 91 million acres. Although it includes a large proportion of the South's agricultural land, over 54 percent of the region is in forest. In the Delta hardwood region, which occupies the flood plains of the Mississippi River from the Gulf of Mexico to the Ohio River, forests cover 42 percent of the 32 million acres of land surface. Although this fertile region has been more intensively developed for agriculture than the other forest regions of the lower South, it also contains a large part of the high-grade old-growth hardwood timber left in the United States. In north Georgia and northeast Alabama, the southern portion of the Appalachian hardwood region occupies approximately 11 million acres, of which 63 percent is in forest growth.

A representative cross section of the forest stands in the lower South can be obtained from a summary of data for 21 of the 34 Survey units inventoried and which have a combined forest area of approximately 83 million acres. Over 75 percent of the forest area is occupied by second growth, while remnants of the original forest occupy only 16 percent. Virgin old-growth timber occupies 6 percent of the forest area, and old-growth stands from which a part of the timber has been cut, an additional 10 percent. Sawlog-size stands of second growth occur on 39 percent of the forest area. The large area in second growth consists almost entirely of natural stands that have come in after cutting, largely without the aid of fire protection or the conscious effort of man. Although this indicates the high recuperative capacity of southern forest land, a considerable proportion of the second-growth areas are lightly or otherwise unsatisfactorily stocked. As a reminder, also, that even the best forest land can be mishandled, 8 million acres of former pine land in the Coastal Pine Region have failed to restock after clear-cutting, or have come back to worthless scrub hardwoods, and are definitely out of the forestry picture for many years to come.

The stand of sawtimber in these 21 survey units totals 123 billion board feet (Doyle scale) of which 56 billion feet are pine; 63 billion, hardwood; and 4 billion, cypress. Seventy-two percent of the pine sawtimber occurs in second-growth stands, while 46 percent of the hardwood and 29 percent of the cypress is in second growth. Sawtimber trees, as the term is used here, are trees that contain at least one usable 12-foot log and that will yield at least 50 percent of their gross volume in sound material;

pines and cypress must have a diameter (outside bark at breast height) of at least 9 inches, and hardwoods of at least 13 inches. Allowance has been made in the estimate for both woods and mill cull.

Because of the construction of, or announcement of plans for, several new pulp and paper mills in the South during the last year, the estimates of the supply of pulping wood in the 21 Survey units (83 million acres of forest land) are of particular interest. The volume of pulping wood in soun trees under 13 inches in diameter at breast height amounts to 220 million cords of pine and 110 million cords of pulping hardwoods and cypress. It should be understood, however, that this estimate includes the capital or growing stock of young timber to which the lumber and other wood industries, including the pulp and paper industry, must look for their future supply, as well as that which is immediately available. The yearly pulpwood requirements of the 20 present and proposed pulp mills in the area covered by this estimate total 2½ million cords.

The expansion of the pulp and paper industry in the South is a factor of prime importance in the future of the forests of this region. By coordinating its demand for small, cheap timber with the requirements of the lumber and other wood-products industries for larger material of higher quality the pulp and paper industry can be of valuable aid in the economic development of the forests of the South. The expansion of the pulpwood market to include all of the naval-stores belt offers an excellent opportunity to "clean up" the large accumulation of worked-out turpentine timber, which has heretofore been almost without a market, and which by its presence has hindered the growth of another crop of trees for turpentining. In stands that are too densely stocked, obtaining pulpwood from thinnings and improvement cuttings offers opportunity to reap an immediate money return and at the same time improve the forest and hasten the growth of the remaining trees to a more valuable size. Although it is undoubtedly possible to manage forests primarily for pulpwood on short rotations, the unrestricted cutting of small trees for pulpwood on lands not under forest management may involve the removal of potential sawtimber and other high-quality material to the future disadvantage of the lumber and other wood-products industries, and may even handicap the pulp mills themselves. A coordination of the demands of the pulp industry with the requirements of the lumber and other wood-products industries is entirely feasible and can be worked out to the advantage of both.

A large item of timber use in the lower South is that for cross ties, poles, and piling. This consumption, with increased utilization of second-growth timber, has been accompanied by a considerable development of the wood-preserving industry. Of particular interest to these industries, therefore, have been the Survey findings in regard to the supply of pole and pile timber. In 16 Survey units situated along or near the Atlantic and Gulf Coasts, it is estimated that there are 263 million pine trees suited for conversion into poles or piles. These trees occur scattered individually or in groups throughout the forest stands, and most of them are accessible. For the 16 units as a whole, 69 percent of the suitable trees will produce poles or piles in the 20- and 25-foot length-classes; 24 percent will produce 30- and 35-foot lengths; and 7 percent will produce lengths of 40 feet or more. Because pole and pile timber is commonly turpentined or cut for sawlogs, pulpwood, and other commodities without regard to its higher value for other uses, and because pole and pile producers and processors are seldom timberland owners themselves, it particularly behooves them to consider the competition they must meet for present and future timber supplies and to guard in some manner their future supply of pole and pile timber.

The analysis of naval-stores data has progressed to a point where a rough appraisal can be made of the possible future production of the entire naval-stores belt. Between South Carolina and east Texas, there are approximately 34 million acres on which longleaf and slash pines form an important part of the forest stand. The supply of unturpentined longleaf and slash pine trees on this area is sufficient to sustain present gum naval-stores production, as well as permit a gradual increase in production. If any considerable number of round trees are cut for pulpwood, poles, piles, cross ties, or sawlogs, however, the possible naval-stores production will be correspondingly reduced. The supply of longleaf pine stumpwood, from which the wood naval-stores industry extracts one-sixth of the turpentine and one-fourth of the rosin produced in the United States, as well as pine oil and many other products, is sufficient to permit a considerable increase in the production of wood naval stores. A smaller item, but one which adds to the total of naval stores produced, is the turpentine recovered as a byproduct in the manufacture by the sulphate process of paper-pulp from southern pines. Attempts are also being made to develop methods for recovering rosin from pulpmill liquors. Although the supply of turpentine timber, stumpwood, and the growing pulpmill activity are favorable for an increased production of naval stores, the industry should move cautiously if the violent price fluctuations and general instability which have characterized the industry for the past quarter century are to be avoided.

A very interesting finding of the Forest Survey is the confirmation of the fact that southern hardwoods have growth possibilities probably fully as great as those of the pines. In the Delta hardwood region of northeast Louisiana, it was found by averaging the fast- and slow-growing trees together as they occur naturally over a forest area of 2½ million acres, that the more rapidly growing hardwood species, such as the red oaks, cottonwood, soft maple, and sweet pecans, compare very favorably in diameter growth rate with the southern pines; while red gum, tupelo, gum, white oaks, and ash grow at a good average rate; and even the slower-growing species, such as overcup oaks, bitter pecan, hickory, and black gum, increase in diameter at an average rate of about 1½ inches in 10 years. The net increase in board-foot volume on the 2½ million acres in question was found to average 72 board feet per acre annually; while the annual increment in the better-stocked stands of second-growth sawtimber averaged 220 board feet per acre. These increment rates, which are woods-run averages under strictly natural conditions, could be increased considerably under forest management. It is believed that the growth of hardwoods on similar sites elsewhere in the lower South, as in the bottomlands of the Savannah, Altamaha, Apalachicola, Mobile, Pearl, Red, and Sabine Rivers, will be found to compare favorably with that in northeast Louisiana.

The few general findings given here indicate, in a limited way, the manner in which the factual data collected by the Forest Survey are defining the different aspects of the forest situation in the lower South. In general the outlook is favorable and definitely encouraging, both as regards the condition of the forests themselves and as regards the attitude of the timber-using industries, timberland owners, and the public in general. There now seems to be enough forest land and enough merchantable and growing timber to support permanently the present forest industries as well as an expanded pulp and paper industry, provided the land and its growing stock of trees are handled with skill and intelligence. There are, however, a number of weak spots that need adjustment and problems that must be solved if the full possibilities of almost two-thirds of the land area of the South are to be realized.

COOPERATING AGENCIES

BUREAU OF PLANT INDUSTRY

Forest Pathology

Accomplishments during 1936

1. A study of the brown-spot needle disease of longleaf pine continued as the main investigation. This study can be divided into three separate parts: (1) determination of the effect of the disease on seedling development, (2) determination of the effect of fire as a method of disease control, and (3) a study of technical phases of the problem.

Examination of a longleaf pine plantation on the Choctawhatchee National Forest in western Florida, where the disease had been kept in check by infrequent spraying (from one to three times a year) for four seasons (1933-36), showed ten times more disease on the foliage of unsprayed seedlings than on the sprayed. Favorable response to infrequent spraying has been indicated in other localities. On the Palustris Experimental Forest in central Louisiana the average infection on the needles of planted longleaf seedlings, sprayed three times in the field during two growing seasons, was 8 percent as against 18 percent on untreated seedlings in adjacent plots. In a cooperative study with the Forest Service, semiannual experimental spraying was extended to a longleaf plantation established during the winter of 1925-26, near Bogalusa, La. This plantation showed poor development on account of heavy brown-spot infection. The initial spraying treatment in July 1936 appears to have stopped further progress of the disease on foliage of that growing season.

Another test of the same type was initiated on the Harrison Experimental Forest in June 1936. The purpose of this test was to determine the effect of the disease of choosing for the time of the second semiannual spraying either September or February.

The study of the effect of fire as a method of disease control was continued. Data gathered on an extensive survey through Florida, Alabama, Georgia, and South Carolina confirmed previous observations that winter fires reduce the amount of infected foliage as compared with that on seedlings in nearby areas that have remained unburned for several seasons.

An estimate of the spread of the brown-spot into an area of natural reproduction, following a single fire in February 1934, covering 40 acres, indicated that infection by the second winter after the fire amounted to three-fourths of that on seedlings in the area outside which had been unburned for 8 years.

Fungi from diseased needles of Austrian and Corsican pines from northern sources were studied in the laboratory to determine their possible connection with the brown-spot disease in the longleaf pine region. Three species or strains of fungi were found on the infected foliage, differing in morphological and cultural characters from each other and from the brown-spot organism.

2. Experimental work to determine whether the losses that have occurred in the raising of black locust nursery stock were due to parasitic factors, was resumed during the growing season. Formaldehyde, aluminum sulphate, and hydrated lime were used on small plots to sterilize the soil and change the soil acidity. New Improved Ceresan, basic copper sulphate, Dubay dust, and zinc sulphate were used as seed dust treatments. Adverse weather conditions and lack of damping-off made it difficult to draw conclusions from the results of this work. Weak formaldehyde, when applied to the soil in water solutions at the rate of 1/8 to 1/[illegible] ounce per square foot, gave good results, but failed to stimulate the seedlings above ground to emerge as has been noted elsewhere.

3. As part of the Federal program to establish blight-resistant chestnuts in this country, Asiatic chestnut seedlings were grown and distributed at the Louisiana State Nursery from 1930 to 1934. A study of the survival and growth of these trees, now located in scattered plantations throughout the South, is being made with particular reference to the pathological factors affecting their development. Two plantations were visited in 1936. One had failed on account of frequent fires and cattle grazing. In the other, a number of the trees had started to bear seed. As these trees had been planted in nematode-infested soil, the roots of several were examined for galls, but none were found. This suggests that Asiatic chestnut trees may be immune to attacks of certain kinds of nematodes.

Plans for 1937

1. It is planned to continue the experiments on the brown spot needle disease in order to determine the minimum number of spray treatments needed to stimulate rapid height growth of seedlings. The pathogenicity of the fungus causing the brown-spot should be determined and a taxonomic study of the same organism made. Technical phases of the problem which may have no obvious economic bearing, but which may indicate better methods of disease control, should be studied.

2. It is planned to discontinue the study of black locust diseases because of the consistently negative results thus far obtained.

3. Several Asiatic chestnut plantations in Louisiana and Mississippi have not been examined since the trees were set out. These are to be examined during the coming year.

Forest Products Pathology

Accomplishments during 1936

Owing to the resignation of Mr. Hatfield in June 1936, the Station was without a products pathologist during the latter half of the year and the work accomplished was consequently limited.

The main work in products pathology for 1936 dealt with (1) studies on the dissemination of sap stain fungi and (2) dipping tests to determine the effectiveness of certain chemicals in preventing sap stain of lumber during seasoning.

Further studies on the agents disseminating sap-stain fungi substantiate the findings of 1935, viz., that the spores of certain stain fungi are abundantly present in the air at mills and seasoning yards where lumber is manufactured and dried. These spores were sufficiently abundant in all localities studied to inoculate effectively and to stain lumber that was not chemically dipped or rapidly dried. The fungi commonly found in the air, however, are not those previously supposed to cause the major stain in lumber. The tests suggest that the fungi thought to be the major cause of stain are probably disseminated largely by some agent other than wind, possibly by insects.

Tests of chemicals to control sap stain of lumber showed another promising chemical, a chlorinated phenol (Santophen-20-S), but additional tests are needed before this chemical can be definitely recommended.

A test was made to determine whether the chemicals used as sap-stain preventatives are effective in lumber that is bulk-piled for periods up to 3 weeks after dipping and before being placed in a regular seasoning pile; inconclusive results were obtained.

In cooperation with the Bureau of Entomology and Plant Quarantine, extensive chemical dipping tests were established in order to prevent insect damage and the accompanying staining of hardwood lumber. The tests disclosed no new chemical which gave promise as a stain preventative. The insect phases of the study were handled by the Station entomologist.

Decay observations were made on the extensive stake test being conducted on the Harrison Experimental Forest by the Forest Service and the Bureau of Entomology and Plant Quarantine. Only the untreated (check) stakes showed evidence of decay, but the test has not progressed sufficiently for definite conclusions.

Plans for 1937

During 1937 it is planned to make:

1. A series of commercial-scale tests of certain chemical dips and promising new chemicals.

2. A more extensive study of the fungi that cause stain.

3. A test of the effectiveness of present dips in lumber that is bulk piled for 15 to 30 days after dipping.

4. A study to determine to what extent log stain develops in lumber that is sawed from stained logs.

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Forest Insects

Bark beetles. This region continues to be free from epidemics of bark beetles. No evidence has come to light to show that summer cutting is not safe when rainfall is approximately normal, and at present there is very little evidence to show that it is not safe even when there is a temporary deficiency in rainfall during the growing season.

Fire is one of the principal causes of bark-beetle attacks, through weakening of the trees. Control measures for the beetles may prove necessary in cases of severe fires.

An investigation in southern Arkansas indicated that no type of damage by logging, wagons, or tractors leads to bark-beetle attack. There was no indication that tractor logging was more injurious than wagon logging. Felling damage which occurs higher up the trunk of the tree often leads to attack by bark beetles.

Defoliators. An illustrated paper on the browning of the needles of young pines by a beetle, pine *Colaspis*, was prepared for publication.1/

Leaf-cutting ants. There is very good reason to believe that damage to young pines by the leaf-cutting ant, *Atta texana* Buckley, in Louisiana can be controlled effectively by the use of carbon bisulphide. This chemical appears to be particularly effective in plantations if the ant nests are treated before planting operations. In case of natural reproduction, similar control has been obtained by treating the ant nests during the summer before the pine seedlings appear in the late winter. An illustrated paper on these types of injury and control is in press.

Nursery Insects

Crop insects. In this region during 1936 very little damage occurred to forest nurseries from insects which normally injure crops. This refers to both pine and black locust. The census of *Phyllophaga* (or adults of white grubs) of this region has been continued, with 34 species reported to

---

1/ Louisiana Conservation Review, January 1937.

date. A card catalog, arranged under subject headings and including publications on both biology and control, has been prepared for this group.

Forest-Products Insects

Ambrosia beetles. Tests of dipping green hardwood lumber in chemicals to prevent attack by ambrosia beetles have given ineffective protection and probably will not be repeated. Tests of spraying the lower half of piles of green lumber indicate that this method may give protection against ambrosia beetles, but it may be necessary to repeat the spraying during the season of flight of these beetles; cresylic acid is showing promising results as a spray. Spraying tests of green hardwood logs in the woods have given inconclusive results, but will be repeated in 1937.

Powder-post beetles. In cooperation with members of the hardwood lumber industry, a large-scale test (including 136 chemicals) to protect hardwood lumber against attack by *Lyctus* beetles is under way at the plant of the Anderson-Tully Lumber Company at Vicksburg, Miss. Ten boards are used for each chemical, one-half of the board being dipped and the other half left undipped. Five boards in each series are piled in a screened shed at the mill, and the remaining five boards are piled in the millyard. In each case *Lyctus*-infested material is placed in the piles.

Biological tests are also under way to determine just how soon different kinds of hardwood lumber are attacked by *Lyctus* beetles.

Considerable educational work has been done at various mills to enable millmen to distinguish between damage caused by ambrosia beetles and *Lyctus* powder-post beetles.

Termites. At the Centennial Exhibition (June to November, 1936) at Dallas, Tex., a frame building (five-room bungalow) embodying the termite-proof features recommended by the U. S. Department of Agriculture was exhibited by the Southern Pine Association and attracted considerable interes

Owing to misunderstanding the Bureau Specifications E-338, metal termite shields are not being properly installed on buildings in New Orleans; these specifications have been rewritten to avoid misconceptions. It is planned to demonstrate proper methods. Photographs of improperly installed metal termite shields on buildings in Louisiana and Mississippi were taken to be used in educational work.

A model of a termite-proof building, illustrating the metal termite shield, and suitable literature, were loaned to the Copper and Brass Research Institute for a meeting at Atlanta, Ga., the week of November 9, 1936.

An illustrated paper on the termites of Louisiana was published in the Louisiana Conservation Review for October 1936. This article emphasized that the municipality is responsible for termite control.

Cooperation is being maintained with the lumber industry, with particular reference to counteracting the exaggerated publicity on termite damage to wooden structures. A paper discussing this matter will soon be issued by the National Lumber Manufacturers Association.

Maps showing the northern limits of termite damage and the distribution of termite damage (to buildings) in the United States, by counties, were prepared.

Continued efforts are being made to have termite-proofing provisions included in city building codes.

Nearly 500 wooden stakes, constituting a series of soil poison tests against termites, were set out near Crown Point, La. As yet there are no results to report.

Pine cone insects. Moths (Dioryctria), ptinid beetles, and fly maggots continue to be the most numerous and injurious of the 37 different species of insects living in pine cones.

Acorn insects. The Soil Conservation Service office at Meridian, Miss., was advised how to fumigate acorns in order to kill Curculio.

Wood Preservatives

Twenty-five chemical wood preservatives, including new promising chemicals, have been employed in impregnation tests by the Forest Products Laboratory, using 100 seasoned pine fence posts for each chemical. These posts will be installed on the Harrison Experimental Forest in southern Mississippi to determine in service tests their resistance to decay and to termites.

The tests of sections of pine trees injected with chemicals, placed in the ground October 17, 1935, after service for 1 year, show promising but, as yet, inconclusive results.

The eighth progress report on the international termite-exposure tests was prepared for publication.[1]

General

On October 18, 1936, a meeting of 35 entomologists of this region was attended at Louisiana State University, Baton Rouge, La. A paper, entitled "Why fundamental research?", on forest insects and their control, was presented. On October 19, conferences were held on local problems and arrangements were made for meetings at least once a year.

Plans for 1937

The work during 1937 will be largely a continuation of that of 1936.

---

[1] Proceedings of the American Wood Preservers' Association, January 1937.

Damage to Longleaf Pine by Birds and Rodents

Investigative work during 1936 was concerned largely with the effect of rodents and birds on the natural reproduction of longleaf pine, and, as during 1935, was centered on the Harrison Experimental Forest, in southern Mississippi. The current scarcity of rodents eliminates them, for the time being at least, as a factor of any importance. Birds were found to be the principal cause of seed destruction. Fortunately there was an unusually heavy cone crop in the fall of 1935, resulting in such an abundance of seed that it was possible to check closely on the agencies responsible for lack of seedlings. Birds apparently are a vital factor in the disappearance of seed and injury to seedlings, as evidenced both by observation in the field and by the analysis of the stomach contents of specimens taken during the late fall and early winter. The species of birds causing the most serious depredations, in descending order of their importance, were: the southern meadowlark, the blackbird, the mourning dove, and the bob-white. Sparrows were of minor importance in this respect, and robins, considered by many to eat pine seed throughout their sojourn in the South, were not found, at any time or under any circumstances, to touch anything but insects and fleshy fruits such as the gallberry and black gum. This present winter (1936-37) has been characterized by an almost total lack of longleaf pine seed, a radically different condition from that existing a year ago, and it has been of decided interest to note the scarcity of a supposedly resident species such as the meadowlark. Only at infrequent intervals have small flocks been encountered, indicating their dependence on pine seed as a source of food during the winter months.

As a check on the effect of birds and mammals on natural regeneration on burned and unburned sites, plots were established in the late fall of 1936 on the Harrison Experimental Forest. These will be followed up with similar plots to determine the time of year when planting with seed can be done with the least damage to seed and seedlings. Data now on hand indicat that direct seeding can be done to best advantage during a season when the normal cone crop is at its minimum and when the meadowlarks and blackbirds are relatively few in number.

Distribution of Rodents on Cut-over Longleaf Pine Areas

Distributional studies concerning the abundance of both rats and mice on cut over longleaf pine land were continued on an even more intensive scale than previously, to verify or disprove the theory that they are norma ly scarce on such sites. These small mammals were as scarce in 1936 as during 1935, very few being caught despite the fact that 320 traps were in continuous operation throughout the period of study. In 1936 eastern Texas an Florida were included in this study, with comparable results on areas simil to those in southern Mississippi. It was of interest to note that the presence of scrub palmetto as the predominating ground cover in northern Florid was associated with perceptibly increased numbers of mice. Only on a very limited area on the Harrison Experimental Forest is this palmetto found, an here mice occur in far greater abundance than elsewhere on the Forest. Thi suggests a possible reason for the surprising scarcity of these rodents in this region.

Damage Caused by Rabbits

Although rabbit damage either to nursery stock or to natural regeneration is rarely serious, local outbreaks have been reported from time to time in eastern Texas and Louisiana.

Distribution of Birds on the Gulf Coast

Because relatively little is known of the distribution and abundance of bird life on the Gulf Coast, some time was devoted to such a study; and, as opportunity offered, brief surveys have been made of the bird life of the coast counties in Mississippi, Louisiana, Alabama, and Florida.

Plans for 1937

Plans for the coming year include a continuation of studies now under way, with a possible expansion of work to include the effect of fire on wildlife, with special reference to silvicultural practices.

PUBLICATIONS

January 1, 1936 - December 31, 1936

Bull, Henry - Pulpwood yields from experimental thinnings in old-field stands of loblolly and shortleaf pines. Occasional Paper No. 57, 9 pp. Dec. 28, 1936.

Craig, Ronald B. - Land ownership in Survey Unit #1, Florida - 1934. Occasional Paper No. 56, 21 pp., illus., Dec. 22, 1936.

Demmon, E. L. - Influence of forest practice on the suitability of southern pine for newsprint. Address before annual meeting of Society of American Foresters at Atlanta, Ga., Jan. 27, 1936. Jour. Forestry 34 (3): 202-210. 1936.

__________ - Rate of formation of heartwood in southern pines. Jour. Forestry 34 (8): 775-776, illus. 1936.

__________ - Some of the results of forest research during the past year. Address before Georgia Forestry Association annual meeting at Columbus, Ga., May 7-8, 1936. Naval Stores Rev. 46 (17): 8, 10. 1936.

__________ - The opportunity for forestry in Georgia's agricultural program. A. & W.P.R.R., the Western Railway of Alabama, Ga. R.R. Agric. Bull., spring issue, pp. 14-17. 1936.

Eldredge, I. F. - Discussion: "Trends and requirements for newsprint paper from southern woods." Jour. Forestry 34 (3): 210-212, illus. 1936.

__________ - The forests of the deep South as a pulp and paper resource. Address before 21st annual meeting of the Southern Pine Association, March 31 - April 1, 1936. Supplement to Southern Pine Bull. 1 (6): 7 pp., illus. 1936.

__________ - The Forest Survey in the South. Southern Lumberman 153 (1929): 27, illus. 1936.

__________ - The Great Survey. American Forests 42 (12): 539-543, 581, illus. 1936.

__________ - The possibilities of a greater production of naval stores in the South. Address before Southern Conference of the Farm Chemurgic Council at Lafayette, Louisiana, Oct. 17, 1936. Naval Stores Rev. 46 (32): 6, 8, 10, 12, 14, illus. 1936.

Eldredge, I. F. - The timber supply in the deep South. Southern Lumberman 153 (1937): 98B-98D. illus. 1936.

——————— - Timber situation in the deep South. 97 billion feet sawlog timber in deep South. Address before meeting of Railway Tie Association, Cincinnati, Ohio, May 21, 1936. Cross Tie Bull. 17 (8): 4, 6, 8-9. 1936.

Forest Survey Staff - Pulping and nonpulping cordwood volume in the longleaf pine region of Mississippi & east Louisiana. Forest Survey Release No. 18, illus. Feb. 10, 1936.

——————— - Pulping and nonpulping cordwood volume in Survey Unit #2. Florida. Forest Survey Release No. 19, 8 pp., illus. April 30, 1937.

——————— - Longleaf pine stumpwood supply in four southeastern Survey units. Forest Survey Release No. 20, 7 pp., illus. Aug. 29. 1936.

——————— - Pole and pile timber in four southeastern Survey units. Forest Survey Release No. 21. 12 pp., illus. Aug. 29. 1936.

——————— - Sawtimber and cordwood volumes in the south Louisiana Delta. Forest Survey Release No. 22, 11 pp., illus. Dec. 18, 1936.

——————— - Forest resources of the Norris Dam Watershed. Unit Report 1, 65 pp., illus. July 15. 1936.

Harper. V. L. - Why small trees should not be turpentined. Naval Stores Rev. 45 (47): 18. 1936. Southern Pine Forestry Notes 10. 1 p. 1936.

———————
and
Wyman. L. - Variation in naval stores yields associated with weather and specific days between chippings. U.S.D.A. Technical Bull. 510. 35 pp., illus. 1936.

Heyward. Frank D. - Soil changes associated with forest fires in the longleaf pine region of the South. Amer. Soil Survey Assn. Bull. 17: 41-42. 1936.

——————— - Soil sampling tubes for shallow depths. Soil Science 41 (5): 357-360, illus. 1936.

———————
and
Barnette, R. M. - Field characteristics and partial chemical analyses of the humus layer of longleaf pine forest soils. Florida Agric. Exper. Sta. Bull. 302, 27 pp., illus. 1936.

———————
and
Tissot, A. N. - Some changes in the soil fauna associated with forest fires in the longleaf pine region. Ecology 17 (4): 659-666, illus. 1936.

Lemieux, F. J. - Log rules, taper tables, and volume tables for use in the South. Jour. Forestry 34 (11): 970-974, illus. 1936.

McKellar, A. D. - The weed problem at the Stuart Forest Nursery, Pollock La. Occasional Paper No. 55, 20 pp., illus. April 9, 1936.

Osborne, J. G. - A bamboo pole for measuring heights in dense young stands. Jour. Forestry 34 (6): 580. 1936.

Pease, Truman E. - Dull chipping tools cause fifteen percent loss in gum yield. Naval Stores Rev. 46 (37): 8, 13, illus. 1936.

Pessin, L. J. - How forest trees reproduce. CCC Gazette 1 (1): 9, 15, 23, 25. 1936.

———————— - Unusual longleaf pine seedlings. Jour. Forestry 34 (8): 817-818, illus. 1936.

Putnam, J. A. - The supply of hardwood timber in the Southern States. Southern Lumberman 153 (1937): 98E-98H, illus. 1936.

Reynolds, R. R. - Good forestry is good business. Southern Lumberman 153 (1937): 127-128, illus. 1936.

———————— - Good lumber from second-growth southern pine. Souther Pine Forestry Notes No. 25, 1 page. 1936.

Snyder, Thomas E. - Bark beetles in relation to selective cutting. Naval Stores Rev. 46 (27): 19. 1936. Southern Pine Forestry Notes No. 24. 1 p. 1936.

———————— - Injury to black locust seedlings in forest nurseries in Mississippi and Arkansas by the lesser corn borer. La. Conservation Rev. 5 (1): 10-11, illus. 1936.

———————— - Termites. Based on an address before the annual meeting of the National Association of Exterminators and Fumigators, Inc., Detroit. SOAP 12 (4): 92-94, 103. 1936.

———————— - The termites of Louisiana and their control. La. Conservation Rev. 5 (4): 26-33, illus. 1936.

———————— and Hunt, Geo. M. - An international termite exposure test. Seventh Progress Report, forty-second annual meeting Amer. Wood Preservers' Assn., Jan. 28-30, 1936. 12 pp., illus.

Southern Forest Experiment Station - Southern Forestry Notes #15. Feb. 1936.

________________ - Southern Forestry Notes #16, April 1936.

________________ - Southern Forestry Notes #17, Oct. 1936.

Spillers, A. R. - A correlation of erosion with land use and slope in the Norris Dam Watershed. Jour. Forestry 34 (5): 492-497, illus. May 1936.

Wahlenberg, W. G. - Effect of annual burning on thickness of bark in second-growth longleaf pine stands at McNeill, Miss. Jour. Forestry 34 (1): 79-81, illus. 1936.

________________ and Gemmer, E. W. - Southern forest ranges. Extract from "The Western Range. A great but neglected resource." U. S. Senate Document 199. pp. 567-580, illus. 1936.

Winters, R. K. - Discussion on land utilization and planning. Address before meeting of Society of American Foresters, Atlanta, Ga., Jan. 28. 1936. Jour. Forestry 34 (3): 269-270. 1936.

Worthington, R. E. and Yencso, Joseph - An investigation in pulpwood production from round and turpentined longleaf pine. Occasional Paper No. 58, 41 pp., illus. Dec. 31. 1936.

Radio addresses

Olsen, C. F. - The place of forests in our daily lives. WWL, April 18, 1936.

Wheeler, P. R. - Human relations in public service. WWL, May 23, 1936.

CLEMSON COLLEGE LIBRARY

SOUTHERN FOREST EXPERIMENT STATION

E. L. Demmon, Director

New Orleans, La.

SEVENTEENTH ANNUAL REPORT

Jan. 1, 1937 - Dec. 31, 1937

SOUTHERN FOREST EXPERIMENT STATION
JANUARY 1, 1937 - DECEMBER 31, 1937

ADMINISTRATION

E. L. Demmon	Director
*Oran Raber	Conservationist
John A. Lubbe	Sr. Admin. Asst.
Coel W. Mills (transf. to Ap.F.S. 1/17/37)	For. & Field Clerk
Vera S. Lind	Sr. Clerk
H. C. Bradshaw (apptd. 5/1/37)	Clerk
Marie M. Flad	Clerk-Stenog.
Agnes G. Terburg	Clerk-Stenog.
*Sarine L. Mullins (transf. to Com.Ex.Admin. 5/10/37)	Asst. Clerk
Helen Schweitzer	Jr. Stenog.
Iretta C. Austin	Telephone Operator

FOREST MANAGEMENT

Verne L. Harper (transf. to Wash. 5/1/37)	Sr. Silviculturist
Philip C. Wakeley	Silviculturist
Henry Bull	Assoc. Silviculturist
Eugene W. Gemmer	Assoc. Silviculturist
J. G. Osborne	Assoc. Silviculturist
L. J. Pessin	Assoc. For. Ecol.
C. A. Bickford	Asst. Silviculturist
Roy A. Chapman	Asst. Silviculturist
Frank D. Heyward, Jr. (resigned 4/30/37)	Asst. Silviculturist
T. A. Liefeld	Asst. Silviculturist
C. F. Olsen	Asst. Silviculturist
*Alrick H. Antonie	Jr. Forester
Morris A. Huberman (transf. to Wash. 3/16/37)	Jr. Forester
*H. H. Muntz (assigned from Region 8)	Jr. Forester
Truman E. Pease	Sr. For. Ranger
*Arthur L. Shepard	Asst. to Tech.
*Robert L. Brooks (apptd. 3/16/37)	Jr. Asst. to Tech.
*Carl W. Cox (apptd. 3/16/37)	Jr. Asst. to Tech.
*Charles D. DeShazor (apptd. 3/16/37)	Jr. Asst. to Tech.
*Lawrence E. Howard (apptd. 3/16/37)	Jr. Asst. to Tech.
*Norman M. Scarbrough (apptd. 3/16/37)	Jr. Asst. to Tech.
*Marquez J. Smith (apptd. 3/16/37)	Jr. Asst. to Tech.
Mary R. Craig	Asst. Clerk
Elizabeth Bergland	Asst. Clerk-Stenog.
Clark H. Streetman (transf. to R-8, 1/16/37 transf. to S.F.E.S. 6/1/37)	Asst. Clerk-Stenog.
May M. Patchett	Jr. Clerk-Stenog.
Marvel H. Gallacher (resigned 3/24/37)	Jr. Clerk-Stenog.
*William G. O'Regan	Jr. Stat. Clerk

FOREST INFLUENCES

H. G. Meginnis	Silviculturist
Lewis M. Turner (apptd. 11/1/37)	Assoc. Conservationist
*M. H. Collet	Jr. Forester
*John L. Gammage (apptd. 3/16/37)	Jr. Asst. to Tech.
*H. W. Gray (apptd. 3/16/37)	Jr. Asst. to Tech.
*Harold R. Johnson (apptd. 3/16/37)	Jr. Asst. to Tech.
Ruth Marshall	Asst. Clerk-Stenog.

FOREST ECONOMICS

W. E. Bond	Sr. For. Econ.
Richard W. Nelson (transf. to Wash. 12/1/37)	Sr. Tax. Econ.
W. G. Wahlenberg	Forester
R. B. Craig	Assoc. For. Econ.
R. R. Reynolds	Assoc. For. Econ.
Ike W. Rawls	Asst. to Tech.
*Henry W. Hughes, Jr. (apptd. 3/16/37)	Jr. Asst. to Tech.
*Conrad A. Robinson (apptd.3/16/37 -appt. term.9/15/37)	Jr. Asst. to Tech.
*Ashley G. Williams (apptd. 9/20/37)	Jr. Asst. to Tech.
Bertha H. Schneider	Jr. Clerk-Stenog.

FOREST SURVEY

I. F. Eldredge	Prin. For. Econ.
Frank A. Ineson	Forest Economist
M. M. Lehrbas	Silviculturist
R. K. Winters	Forester
J. W. Cruikshank	Assoc. For. Econ.
E. B. Faulks	Assoc. For. Econ.
V. B. Davis	Assoc. For. Econ.
John A. Putnam (resigned 9/9/37)	Assoc. For. Econ.
A. R. Spillers	Assoc. For. Econ.
P. R. Wheeler	Assoc. For. Econ.
Geo. E. Morrill (transf. to Ap.F.S. 5/16/37)	Asst. For. Econ.
Harry F. Smith	Asst. For. Econ.
Wm. S. Stover	Asst. For. Econ.
*T. C. Evans	Jr. Forester
Halsey M. Hicks (transf. to N.E.Sta. 5/1/37)	Jr. Forester
Geo. B. Ward, Jr.	Jr. Forester
*R. D. Andrews	Draftsman, Civil Eng.
*Peter W. Chestnolvick	Asst. to Tech.
*Don M. Wallace (furloughed 9/8/37)	Asst. to Tech.
Camelia M. Larsen	Clerk
*Julia O. Dumestre (transf.to Com.Ex.Admin. 10/1/37)	Asst. Clerk
Lucille P. Olsen	Asst. Clerk
*Elsa M. Rayl	Asst. Clerk
*M. Madeline Archinard	Asst. Clerk-Stenog.
*Chas. H. Langhoff, Jr.	Asst. Stat. Clerk
*Martha E. Nelson	Sr. Tab. Equip. Op.
*John E. Lau	Jr. Clerk-Stenog.
*Elmire A. Even	Jr. Cal. Mach. Op.
*Hannah M. Carpenter (resigned 6/30/37)	Jr. Cal. Mach. Op.
*Elizabeth S. Cotten (appt. term. 10/26/37)	Jr. Card Punch Op.

STAFF OF COOPERATING FEDERAL BUREAUS

Bureau of Plant Industry

P. V. Siggers	Assoc. Pathologist
A. F. Verrall	Asst. Pathologist
*Howard Lamb	Junior Pathologist

Bureau of Entomology and Plant Quarantine

T. E. Snyder	Sr. Entomologist
Ruth E. Wood	Asst. Clerk-Stenog.

Bureau of Biological Survey

Thomas D. Burleigh	Assoc. Biologist

CONTENTS

Page

Introduction.......... 1
Current investigations and plans for 1938:
  Forest management.......... 4
    Silviculture.......... 4
    Fire.......... 6
    Regeneration.......... 8
    Naval stores.......... 10
    Mensuration.......... 11
    Fundamental studies.......... 13
  Forest influences.......... 14
  Forest economics.......... 16
    Private forestry investigations.......... 16
    New public domain.......... 18
  Forest survey.......... 19
  Cooperating agencies.......... 22
    Bureau of Plant Industry.......... 22
      Forest pathology.......... 22
      Forest-products pathology.......... 23
    Bureau of Entomology and Plant Quarantine.......... 24
      Forest-tree insects.......... 24
      Forest-nursery insects.......... 25
      Forest-products insects.......... 25
      Wood-preservatives and chemical poisons for fibre boards.......... 25
    Bureau of Biological Survey.......... 26
      Bird and rodent damage.......... 26
      Distributional studies.......... 26
Publications.......... 28

SEVENTEENTH ANNUAL REPORT

of the

SOUTHERN FOREST EXPERIMENT STATION

January 1, 1937 - December 31, 1937

INTRODUCTION

The most important development in forestry in the South during 1937 was occasioned by the continued expansion of the pulp and paper industry in this region. This rapid expansion of an industry whose most important single item of cost is wood, increases the opportunity for the practice of forestry but also presents certain dangers which should not be overlooked. This growing industry brings into the South additional capital, employment, and business, but its rapid growth has raised important questions concerning the quantities and availability of raw material which it needs and the effect which it may exert on the sources of supply of existing industries also dependent on the forest. The pulp and paper industry has shown it is taking cognizance of these factors, and during 1937 has begun to regulate itself so far as forest-conservation practices are concerned. The Southern Station, recognizing its responsibilities in connection with these new developments, is arranging its program to answer many technical questions of forest production and integrated utilization raised by the rapid expansion of the pulp and paper industry.

On January 1, 1938, in the 10 Southern States from Virginia to Texas, there were in operation, or under construction, a total of 38 pulp mills, with a total reported capacity of about 10,000 tons of pulp per day. Most of these mills are close to the coast line of either the Atlantic Ocean or the Gulf of Mexico, but progressively more mills are being built back from the coast in areas of high potential value from the standpoint of raw material. The distribution of these pulp mills by states, is as follows.

Alabama	3
Arkansas	2
Florida	5
Georgia	2
Louisiana	7
Mississippi	3
North Carolina	4
South Carolina	3
Texas	2
Virginia	7

It is estimated that these mills will require approximately 5 million standard cords of rough wood annually and that they will provide employment on a yearly basis for about 39,000 men, of which 23,000 will be employed in the mills and 16,000 in the woods. It is also estimated that the total investment in these 38 plants approximates $200,000,000. Most of these mills manufacture sulphate or kraft pulp, and a few are making bleached sulphate pulp. The majority of the mills run entirely on southern pine, but a few use hardwoods or a combination of pine and hardwoods. The principal product is kraft wrapping paper, kraft liner, and kraft boxboards; whereas the bleached sulphate pulp goes into book or other white paper. A few mills manufacture wallboard, and one of the mills under construction will make rayon; but there is not yet in operation in the South a mill manufacturing newsprint.

It is obvious that this development of the pulp and paper industry offers distinct advantages to the South. This investment of $200,000,000 of capital, most of which came from outside the region, has been distributed in each of the 10 states. The 39,000 employees will, in large measure, be drawn from the Southern States, and it is roughly estimated that the payroll of these mills will total not less than $25,000,000 a year. Another advantage accruing to the South will be increased business for railroads and other transportation systems. No estimate is available as to the amount of this increase, but the transportation of raw materials to the mills and of finished products from the mills will, of necessity, provide considerable additional business for the South's carriers. Still another advantage lies in the increase of taxable assets. Several states have enacted legislation granting temporary tax exemptions to new pulp mills within their borders. While the $200,000,000 invested in plants has added that much to the taxable wealth of the South, the increase actually will be several times this figure, since (a) the products of the industry are subject to taxation, (b) considerable land which has been off the tax rolls through delinquency has been restored thereto, and (c) the mills themselves have acquired a certain acreage of land to supply a portion of their wood requirements.

The advantages listed above accrue in large measure to the general public. The owner of southern timberlands, whether an individual or a corporation, stands to profit, particularly if proper care is exercised in the management of the timber stands. The pulp industry offers an opportunity to dispose of low-grade material for which no other profitable outlet is available. This material includes limby, crooked, or defective trees that may come out in improvement cuttings, suppressed trees and others removed as thinnings, the upper portions of sawlog-size trees cut in logging operations, and worked-out turpentine trees. The removal of this material makes stand improvement profitable and also provides the basis for more completely integrated utilization. Indeed it is only through stable outlets for all of the products of the forest that good forestry can be made profitable.

While recognizing the above advantages, attention should also be given to the dangers inherent in the expansion of the pulp and paper industry. Many of these new mills are concentrated along the seaboard, where the competition for raw material will be keen. Furthermore, the pulp and paper industry is not the only one dependent upon the South's forests. Preceding it by many years are the lumber, naval stores, pole and piling, and other wood-using industries. If conservative cutting practices and other forestry measures are followed by each of these industries, the forest resource, except perhaps in limited areas, probably will be found ample. Integrated utilization on a sustained-yield basis, therefore, should be the aim of any permanent forest industry; this means that the forest resources are harvested for the purpose which continuousl yields the greatest profit for an indefinite period of time. The growth of industry and the need for the permanent employment of both people and land demand that progressively more wood be grown. The South's wood production, therefore, must be correspondingly increased to approach the full capacity of its forest lands to produce.

For several years past, southern pulp mills have obtained their raw material at very low costs. Usually the mills arrange to obtain their pulpwood through contractors, who buy directly from farmers or landowners at the lowest price obtainable. With the recent expansion of the industry, competition has increased and pulpwood prices have advanced. During the last year, the U. S. Forest Service has set a minimum price of $1.00 per cord for sales of pulpwood from national forests in the Southern Region.

Recognizing both the advantages and the dangers inherent in the establishment of this new industry, the southern representatives of the American Pulpwood Association met in New Orleans, La., on May 3, 1937, and adopted the following statement of policy:

1. It is agreed that all land, including non-company land, must be cut over in a manner which will maintain and build up the forest growing stock.

2. It is agreed that each pulp mill operator will employ the necessary qualified personnel to insure proper compliance with agreement #1.

3. It is agreed that the southern pulpwood consumers shall be divided into working groups for the purpose of preparing proper regional rules of forest practice.

4. It is agreed that a working committee shall be appointed for each regional group in cooperation with Federal and State agencies to formulate and place into effect the cutting procedure for each group in order to carry out agreement #1.

5. It is agreed to satisfy to the fullest practicable extent, the requirements of each mill from improvement cuttings, worked-out turpentined timber, and salvage from sawtimber cuttings.

6. The industry recognizes that Federal and State forest fire protective organizations, as now constituted, are inadequate, and urges their extension and pledges the industry's cooperation in securing more effective forest fire control.

7. The industry agrees to secure insofar as possible the full compliance of its wood producers with the procedure of forest practice as established for each group.

The Southern Region was subsequently divided into four districts, and representatives of each met and adopted simple rules to control cutting and to promote conservation practices on pulpwood operations in their respective districts. Although these rules were not considered adequate to obtain optimum forest management, they did represent the minimum measures that would provide for continued production. The execution of these rules has proceeded rather slowly. A second meeting of representatives of the southern pulpwood industry was held in Jacksonville, Fla., on Dec. 6, 1937, to check up on the progress made. At this meeting the representatives of the pulpwood industry and of public forestry agencies agreed to continue and strengthen the efforts to obtain full compliance with the conservation rules as previously adopted, but admitted that these rules are but a first step toward sound forest management for pulpwood operations.

There is abundant need for forest research on the financial possibilities of forestry and on the management of forest properties, including proper methods of cutting and the increasing of forest growth. Forest Survey data on the volume, growth, and drain of our forest resources, as well as the results of other studies now under way at the Southern Station, are urgently needed. In the longleaf-slash pine area of the Southeast, there is needed a study of the costs and returns of sustained-yield management and integrated utilization, similar to the study that has been carried on during the past several years near Crossett, Ark., in the shortleaf-loblolly pine type.

Studies of methods of cutting for pulpwood or other forest products have been initiated during the last year on the Crossett Experimental Forest in Arkansas and on the San Jacinto forest in Texas, both in the shortleaf-loblolly type. There is need for similar studies in the longleaf-slash pine belt of the Southeast, where critical problems are now arising. Also the results of the Forest Survey have been in great demand by the forest industries of the South, and these data should be kept current if they are to be of the most benefit. In each of its fields of investigations, the Southern Station has an opportunity to contribute to the solution of the problem of building up and utilizing to the best advantage the South's most valuable natural resource, one which occupies 60 percent of its land area—its forests.

While it is generally recognized that the recent rapid expansion of the pulp and paper industry in the South can be of great advantage to the people of this extensive region, it must be borne in mind that only through good forest management and the adoption of integrated utilization on a sustained-yield basis can these inherent values be made permanent. The future research program of the Southern Station will be formulated so as to assist in arriving at these objectives.

CURRENT INVESTIGATIONS AND PLANS FOR 1938

FOREST MANAGEMENT

Substantial progress has been made during the past year in each of the six major Forest Management projects: Silviculture, Fire, Regeneration, Naval Stores, Mensuration, and Fundamental Studies. In addition to regular project work, the members of the Forest Management personnel have devoted much time to cooperating with Federal, State, and private foresters in the region, and to helping them attack and solve various problems in practical forest management. Progress has also been made in developing the Station's experimental forests both for research and for practical service.

SILVICULTURE

Information on the best methods of handling second-growth stands of southern pines is far from adequate to supply the ever increasing demand. The rapidly developing market for small material such as pulpwood, and the continuous demand for poles, piling, and sawlogs, emphasize the need for reliable data on methods of cutting and thinning, and on other stand-improvement measures. To furnish such information in the shortleaf-loblolly-hardwood type, two series of comprehensive long-term cutting experiments were started in 1937, one on the Crossett Experimental Forest near Crossett, Ark., and the other on the San Jacinto Experimental Forest near Huntsville, Tex. Although results from these experiments will not be available for some years, early re-examinations can be expected to give valuable indications of desirable practices.

Recognizing the need for immediate information on which tentative stand-treatment practices can be based, a study of stand conditions following commercial cuttings of southern pine pulpwood is well under way. During 1937, five hundred 1/10-acre sample plots, taken on areas cut over 2 to 12 years previously, were measured in Louisiana, Arkansas, Mississippi, Alabama, and Florida. Preliminary analysis of the data indicates that 10 years after cutting there is usually less than 5 cords per acre available. Moreover, in the residual stands containing less than 5 cords per acre 10 years after cutting, only about 3 percent of the plots examined were at least 50 percent stocked with pine reproduction (2,000 seedlings per acre is considered full stocking for shortleaf and loblolly and 1,000 for longleaf). On these areas, reproduction since cutting has presumably failed largely because of frequent surface fires and lack of an adequate seed supply. Control of these two factors should result in much better reproduction, but other factors also need investigation.

The effects of different seedbed conditions on the establishment and early survival of longleaf pine seedlings were worked out on the Harrison Experimental Forest. Observations 18 months after a heavy seed fall on small plots around isolated longleaf pine seed-trees, equally exposed to birds and rodents, indicated that (a) exposure of mineral soil by burning or by cultivation decreased the "catch" of longleaf pine seedlings, probably due to the fact that seed-eating birds were very common and tended to feed most heavily where the cover was scantiest; (b) early survival of the seedlings was equally good on burned, cultivated, and natural "rough" areas; and (c) enough seedlings (at least 3,000 per acre) were present under all conditions to provide adequate stocking.

Intensive studies of the growth rate of individual second-growth slash pines in relation to their spacing and various crown characteristics were continued. Two basic growth-rate charts have been constructed (one for dense stands and one for open stands), each of which provides a method of estimating current rates of growth (in terms of number of rings per radial inch) from age and relative crown-spread. Since relative crown-spread is readily computed from the average spacing in a stand, growth rate and hence future diameter can be estimated for different spacings created artificially by thinning. It is expected that when completed this study will permit the presentation of desirable thinning schedules for specific stands and for specific products.

Plans for 1938

1. Current studies of thinning, pruning, and the silvicultural improvement of stands will be continued.

2. The study of the growth rate of slash pine in relation to spacing and crown characteristics will be completed and prepared for publication.

3. The analysis of data on stand conditions following commercial cuttings of southern pine pulpwood will be completed and prepared for publication.

4. New work will be initiated on the relation of tree characteristics and stand conditions following different kinds of harvest cuttings to the growth of loblolly and shortleaf pines, the results of which will be of practical value in marking trees for cutting.

5. A series of harvest cuttings in longleaf and slash pine is planned for the Olustee Experimental Forest in Florida, in order to demonstrate and evaluate different kinds of cuttings.

FIRE

The program of the fire project is directed toward the solution of problems in the development of (a) improved fire-protection methods; (b) a satisfactory method of evaluating the effects of fire; and (c) a technique of controlled burning that is both economical and effective. Past work at the Station has been principally on the study of the effects of fire, but an increase in the personnel assigned to the fire project during the past year has permitted its expansion to include a study of other fire-protection problems. Field studies of fire-protection methods have been aimed especially at supplying information needed in the Service-wide replanning of fire control now in progress.

The basic requirement of good fire protection is a dependable detection system—the so-called eyes of the service. The ground work for determining the requirements of an adequate detection system was laid by a series of tests (a) of discovery time for experimental fires whose time of origin was accurately known, and (b) of visibility, as measured by a specially designed haze meter. It was found that two-thirds of the fires set were discovered from towers 5-1/2 to 10 miles away before the fires were 0.3 acre in size. Range of vision was found to vary greatly both with time of day and direction; obviously both of these factors must be taken into consideration in planning methods of detection.

Burning conditions—the key to the size and type of suppression organization needed—were subjected to a number of tests. For economic reasons it is essential to determine the conditions under which there is no fire danger, i.e., when the fire-control organization can be dispensed with, but this requires a knowledge of the laws of combustibility. The highest moisture content at which the fuels could be ignited and would burn without additional ignition varied with the type of fuel, but ranged, in general, from 30-35 per cent when there was no wind to 40-45 percent with winds of 5-10 miles per hour. Degree of combustibility is being tested for a complete range of moisture contents and wind velocities. To provide a ready index of fuel moisture and therefore of fuel hazard, moisture gains and losses by sample materials were compared with gains and losses by typical fuels under the same conditions. Of 59 materials tested, small cypress sticks and a rattan mat showed the closest relationship and are being subjected to further tests.

The true measure of the effect of weather and fuel factors lies in the rate of spread of fire and its resistance to control. These factors determin the size of organization and equipment needed, and the best method of suppression. Approximately 130 test and wild fires were mapped at 1-minute interval to determine rate of spread. On each of these fires complete data were taken on weather and fuel conditions together with partial data on the rate of fire line construction by typical crews. Rate of spread and resistance to control were found to mount rapidly both with increasing velocity of wind and with decreasing moisture content of fuel. Analysis of these and of additional data planned will be used in the preparation of a fire-danger meter, which will serve as a guide to the strength of the fire-control organization needed, the size of crew to be dispatched to an individual fire, and the most profitable tactics to be employed in its suppression.

An early knowledge of impending fire-weather conditions is a real aid to fire-control organization. A cooperative study was conducted with the New Orleans office of the Weather Bureau to determine the accuracy with which maximum temperature and wind velocity, minimum relative humidity, and rainfall occurrence can be predicted. Using 3 different localities (south Arkansas, central Louisiana, and south Mississippi) as a basis, it was found that minimum relative humidity was as much as 6 percent below the forecast 16 percent of the time, and as much as 21 percent below only 2 percent of the time. Maximum wind velocity was within the range forecast 53 percent of the time. When no rain was forecast, the forecast was correct 83 percent of the time; whereas forecasts of rain were correct only 52 percent of the time.

In the development of a method for evaluating fire effects, a study was begun to determine the average growth reduction and mortality of longleaf pine of various sizes, according to the time of day and season of the fire. Results of this study should provide a preliminary basis for evaluating fire-control expenditures.

A measurement of the effect of controlled burning under one condition was obtained when the analysis of measurements in an 8-year-old slash pine stand, burned under control following thinning, showed that burning did not affect the height growth during the 2 years immediately following the fire. The data indicate a high mortality in longleaf pine reproduction from annual fires, either controlled or wild, but very little mortality from controlled fire 3 years after establishment of the reproduction.

Plans for 1938

1. The study of rate of spread and resistance to control will be continued and extended to include the more important types in the Station territory.

2. Visibility and discovery time, combustibility, and inflammability index studies will be continued and, where feasible, expanded. A tentative fire-danger meter will be prepared.

3. Data on the mortality of longleaf pine seedlings from annual light, annual heavy, periodic light, and periodic heavy, fires will be analyzed and a report prepared.

4. Studies of controlled-burning technique and of damage from average fires will be continued.

5. A study is to be initiated to determine the effect on tree growth of various amounts of defoliation from fires occurring during the different months of the year.

6. Work will be continued in a demonstration of forest management, where controlled burning is employed as a silvicultural and protection measure.

REGENERATION

The Southern Station territory contains more than 5,000,000 acres of cut-over pine lands, mostly longleaf, on which there is little or no possibility of reestablishing forests by natural means. The object of the regeneration project is to supply the owners and managers of these lands with the technical information needed to reforest them successfully by planting.

If artificial planting is to succeed where natural processes of forest reproduction have failed, the planters must have reliable information concerning every step of all the processes, from forecasting the crops of the necessary seed to planting the seedlings in their final positions in the field. These processes include collection, extraction, cleaning, storage, testing, and other treatment of seed; the sowing and all the complex care of nursery beds; maintenance of nursery soil fertility; lifting and shipment of nursery stock; selection and preparation of planting sites; and planting by methods that will insure survival, and at spacings and in mixtures that will insure good development of the planted trees. Any gap in this information threatens the success of a business in which there is currently being invested—that is, in total planting costs—in the Station territory between half a million and a million dollars annually.

The information most urgently needed in connection with Southern forest-tree seed includes the effect of geographical source of the seed upon success of plantations, an index to the maturity of southern pine cones, methods of storing seed (especially longleaf pine) for both short and long periods, and improved ways of testing the ability of seed to germinate. In addition, there are needed each year (1) a reliable estimate of the location and abundance of the seed crop of southern pines, and (2) a series of germination tests of the seed used currently in all Forest Service nurseries in the South.

During 1937 the project staff established 121 plots near Alexandria, La., to test seed from 44 geographic sources, and helped over a score of cooperators establish similar sets of plots throughout the southern pine region. Much simpler loblolly pine plots of the same general nature, established at Bogalusa, La., in 1927, were re-examined; they were found to show marked differences in height growth and very striking differences in resistance to Cronartium rusts, depending upon the geographic origin of the seed. An index to the maturity of southern pine cones, based upon their specific gravity, was developed to the point of practical usefulness in the field; its general use should save thousands of dollars hitherto lost by collecting cones too green to open. Storage at low temperature was found effective in maintaining the viability of longleaf, slash, loblolly, and shortleaf pine seed for 6 years. A comprehensive study of overwinter storage of longleaf pine seed showed that its moisture content when placed in storage might be as important a factor as temperature in affecting its keeping qualities; the results of this study indicated possible savings of approximately $40,000 a year in each of two Forest Service nurseries. Technique for testing germination was improved by discovering a significant beneficial effect of light upon germination, varying according to the condition of the seed. Germination tests were made for practically all seed lots used in the nurseries of Region 8 of the Forest Service. The Station's seventh consecutive annual estimate of the cone crop of southern pines was compiled and distributed to forestry agencies throughout the South and elsewhere, together with notes on local collectors and their supplies.

Among the most urgent nursery problems in the Station territory are the attainment of a satisfactory number of trees per 100 seeds sown; the building up and maintenance of soil fertility; and the taking of an inventory of the millions of seedlings produced each year promptly and accurately enough to permit efficient management of the planting crews. During 1937 much of the difficulty of obtaining good production of longleaf pine seedlings in the nursery was traced to the seed itself. A comprehensive study of soil amendments other than fertilizers (including compost, peat moss, charcoal, and sand), applied to the four principal species of southern pine at the Stuart Nursery in central Louisiana, produced striking results of direct usefulness in improving nursery practice. A thoroughly practical means of making an inventory of the total number of seedlings in the nursery and a fairly effective means of making an inventory of stock of plantable grades were devised and tested. Very promising results were also obtained in a combined study of watering and cultivation, carried out at the suggestion and with the cooperation of Region 8 of the Forest Service.

The effects exerted upon plantation survival by root length, depth of planting, and care and injury of planting stock, obtained in 1936, were confirmed by a new series of plots; and additional survival plots yielded much new data not yet worked up completely.

Plans for 1938

1. The value of the index to cone maturity will be confirmed and its method of determination refined.

2. A comprehensive study of the effect of moisture content of longleaf pine seed upon keeping quality, reaction to kiln temperature, and reaction to air temperature after cold storage, will be completed, and a similar study with slash pine will be started.

3. Germination testing technique will be refined still further.

4. The cone-crop estimate will be made again.

5. Service testing for Forest Service nurseries will be continued.

6. Seed studies will be extended to southern hardwoods as opportunity offers.

7. The fertilizer and soil amendment studies will be continued and extended.

8. The method of inventorying stock by grades will be improved.

9. The survival studies will be continued and expanded to include

the effects of site preparation, of season of planting, of variously defining the grades of planting stock, of ground cover, of internal food supply of the seedlings, and of stimulation of the roots by various means such as plant hormones.

10. A study of the effect of mixture of species in reducing tipmoth attack and in overcoming tipmoth injury in plantations will be undertaken in cooperation with the Bureau of Entomology and Plant Quarantine.

11. New plots will be established to study the conversion to pine of worthless brush stands of scrub oak.

NAVAL STORES

The depressed demand for naval stores in recent years, due to general business inactivity, together with increasing production of wood naval store and increased use of mineral spirits, has aggravated the oversupply of gum naval stores, and prices have reached extremely low levels. Unless production is controlled or consumption is increased, the naval stores operator must lower his production costs or be forced out of business. With a view toward furnishing information basic to the reduction of production costs, th Station program embraces two main lines of endeavor. First it is attempting to search out and make known the effect of all factors which influence the production costs under the present production methods or with slight modifications thereof. Secondly, it is directing its work toward improving the methods of extracting gum from the tree. The first of these should provide the chipping specifications, width of face, and plan of working, i.e., beginning size, working and resting periods, and frequency of streaking, for optimum yields and maximum financial returns. This information is essential i the development of a system of management for turpentine forests with integrated utilization for other products. The second field of work must be based on a thorough knowledge of the physiology of gum production in the tre and the various factors affecting the flow of gum. The use of chemical reagents to stimulate and prolong production, and the introduction of differen methods of wounding, are hopeful avenues of work.

In investigating the possibility of further production from life-bars of trees with two or more worked-out faces, yields from narrow, single and double, French-style faces were compared with those from American-style face of the same width. French faces yielded approximately 20 percent more than similar American faces during the first year, but slightly less during the second year.

An investigation of yields of young vigorous slash pine using different chipping specifications showed that dry facing was negligible when the chipping did not exceed 1/2-inch in depth. These data, coupled with an analysis of all available data from numerous past studies, permit the constrution of gum-yield tables (based on species, diameter, growth rate, width of face, and year of work) from which naval stores yields from a specified crop can be estimated. Analysis is well under way toward a complete evaluation o the financial gains to be expected from working higher-yielding timber in terms of higher grades of rosin and increased turpentine yields.

In the study of individual streak-yield behavior during different seasons, streaks on longleaf and slash pine were allowed to run dry. Rate of yielding was found to vary greatly by seasons, indicating that greater profit may be derived by varying the period between streaks according to the season. During the winter, for example, slash pine yielded 50 percent as much during the second week of a streak as during the first week, and in the summer longleaf yielded 76 percent of the first week's yield during the first 3 days. Since too frequent streaking may impair the vitality and yielding capacity of a tree, and since too infrequent streaking may induce pitch-soaking with consequent reduced yields, some modification of the theoretically optimum streaking-frequencies may be desirable. Accordingly, an investigation is being made of yield over several seasons, when frequency of chipping is varied with the season of the year.

To investigate further streak-yield behavior as influenced by weather, a cabinet for controlling temperature and humidity has been constructed and tested preliminary to initiating formal studies.

In the investigation of the effect of fire on naval stores yields, field or analysis work was completed on three studies, which complete the series planned. Treatments were reversed on two plots on which the effect of controlled surface fires on gum yield of longleaf pine was being tested. The unburned plot, which yielded 3.75 percent less in 1934 and 4.97 percent less in 1935, yielded 2.76 percent more in 1937 when it was burned for the first time and the plot previously burned annually was protected for the first time. Field work was completed in a test of the effect of defoliation on the gum yield of slash pine, in which 65 slash pine trees whose previous yields were known were defoliated from 0 to 100 percent and turpentined uniformly; these latter data have not yet been analyzed. Also a study was made of trees on which turpentining was resumed after a severe fire. By judicious use of jump-streaks, the operator obtained less than 25 percent dry-face on 68 percent of the trees. On only 3 percent of the trees with less than 25 percent dry-face was it necessary to jump more than 5 inches. Dry-face was higher for slash than for longleaf pines and was higher when the face was on the leeward side (at time of fire) than when on the windward side of the tree. Based on these and previous studies, reports are being prepared on the effect on gum yield of defoliation, face burning, and controlled ground fires.

Plans for 1938

1. A comprehensive test of the stimulation of gum yields by chemical reagents will be conducted.

2. Data on the effect of advanced streaking on yields and of different chipping specifications on the yield of vigorous, young slash pines will be analyzed, and reports prepared.

3. The frequency-of-chipping study will be continued, and all of the Station's work on chipping methods will be summarized for formal publication.

MENSURATION

All forest management must have adequate and accurate information on the volume of timber and its rate of growth on relatively small units. Since present methods of obtaining such information in the southern pine region are in many cases inaccurate as well as expensive, the primary objective of the mensuration project is to make available more satisfactory information on the rate of growth and mortality of southern pines and on methods of estimating the volume of standing and felled timber; a secondary object is to aid in the improvement of technique of design and analysis in other fields of forestry research.

During the past year the emphasis of the work has been mainly on (1) growth of turpentined trees, and (2) experimental technique. A preliminary study of the former, which was reported by V. L. Harper (Occasional Paper 64), indicated that for longleaf and slash pines, the average reduction in growth rate (as measured in cubic feet) during the turpentining period is approximately 27 percent for 1-faced trees and 40 percent for 2-faced trees. Additional work was started during the past year to supplement this study and to give information on the tree circumference available for facing. The field work and computations on this study have been completed, and when the results are correlated with existing gum-yield figures, they will be useful in making management plans for the naval stores region.

In the field of experimental technique, numerous improvements have been introduced in the design and analysis of experiments. In order that the newer method may be available to individuals making forest-plantation survival studies, some of the fundamentals of experimental design were presented in Occasional Paper 69. The results of other portions of this work have been put in form for publication.

In a problem dealing with technique of sampling in forest nurseries, it was found that for longleaf pine a 1-percent sample of each of 54 beds would give a satisfactory estimate of the total number of seedlings in the bed. The standard error of the mean was 3.23 percent. It was also found that in estimating the number of plantable seedlings lifted from a group of beds, for 54 beds a 5-percent randomly selected sample of each bed gave an estimated total within 0.1 percent of the actual number. A 1-percent sample gave an est mate within 6.4 percent of the actual number.

Plans for 1938

1. The study of growth of turpentined trees will be completed, and a report prepared.

2. The assembly of volume tables and converting factors will be completed.

3. The advisability of making general taper tables for use in constructing local volume tables for different products will be investigated.

4. All previous growth and yield studies for the southern region will be reviewed.

5. The study of nursery sampling technique will be completed.

6. A study of plantation sampling technique will be started.

FUNDAMENTAL STUDIES

Basic studies pertaining to the physiology of trees and to the environmental conditions to which trees are subject are essential for the successful application of silvicultural practices in the management of forests. Whether it be in natural forests or in plantations, one problem that concerns the silviculturist is the effect of root competition on the growth and development of the trees. In order to determine the degree of root competition, it is necessary first to see what relation exists between the roots of the different species that grow in the stand. With this object in view, a study was made of the roots of 13-year-old longleaf pine seedlings, which were still in the grass stage, and of the grasses, herbs, and other trees that were associated with them. It was found that under natural field conditions the roots of longleaf pine seedlings often display considerable variation in size and distribution,owing to the presence of old root holes, charcoal pockets, and also to differences in soil texture. The lateral roots of the longleaf pine seedlings were confined mainly to the upper foot of the soil and were most abundant in the upper 6 inches, where most of the grass roots also occurred. The total length of the lateral roots of a 3-year-old blackjack oak was more than five times that of the lateral roots of 13-year-old longleaf pine seedlings.

In a study of methods of releasing longleaf pine seedlings from grass competition, three methods were tried: (1) Use of various chemicals in killing ground cover around the seedlings; (2) removal of the grass by hoeing at different seasons of the year and at different distances from the seedlings; and (3) removal of the grass by separate and combined treatments of hoeing, plowing, and burning.

An exploratory experiment on the "tank culture" of longleaf pines in full nutrient solution indicated possible new fields in nursery practice. Seedlings grown in this way were thrifty and well developed. The seedlings grown in solutions lacking various essential plant foods, however, were in most cases not so thrifty. The descriptions of longleaf seedlings grown without certain essential elements (as presented in Occasional Paper 65) should be useful to nurserymen in diagnosing some of their troubles.

The effect of fire on the soil has always interested foresters. A study of 44 test fires under different fuel and weather conditions in longleaf pine forests revealed that in no instance was the maximum temperature sufficiently high to cause charring or destruction of dry organic matter in the soil. A report of this study was prepared for publication.

Fire apparently affects the soil moisture, however, as was indicated by a study of four pairs of burned and unburned plots in longleaf pine forests in Florida, where it was found that unburned soils had a higher moisture content throughout the year than burned-over soils.

Plans for 1938

1. Current studies will be continued.

2. A study will be initiated to determine (a) the site preference and successional relations of important forest types, and (b) plant indicators of different sites.

FOREST INFLUENCES

Prior to 1937, research in forest influences has been carried on under two related types of investigation, viz., water-cycle studies and watershed-improvement studies. These investigations have gone forward at two work centers. The earlier studies, which were started in 1929 and are applicable to the loessal region of Mississippi and adjacent portions of the Gulf Coastal Plain, have been concentrated on the Chewalla Experimental Forest near Holly Springs, Miss. During 1936, water-cycle studies were started also on the Irons Fork Experimental Forest in the Ouachita Mountain region of west-central Arkansas, as detailed in the Station's Sixteenth Annual Report. In 1937, a third project, consisting of preliminary examinations and surveys of watersheds, was inaugurated, as authorized in the Flood Control Act (Public 738) of June 22, 1936.

Work under the new flood-control surveys project, which was a major activity during 1937, cut heavily into the work program for the water-cycle and watershed-improvement investigations, particularly limiting the analysis of data and reports of results from studies under way at Holly Springs. Another activity not directly connected with the above projects but relating to the influences research program and requiring much attention during the year, was service by a Station representative on a number of field committees of the National Resources Committee.

Under the flood-control survey project, preliminary examinations were made and reports virtually completed for the Pearl River basin (Miss. and La.) and the Coosa River watershed (Ala. and Ga.). Other bureaus were assisted in completing the preliminary report for Trinity River, Tex. The Station collaborated with the War Department in holding joint public hearings for Fourche Bayou (Ark.), Poteau River (Ark. and Okla.), and Pearl River (Miss. and La.). Station representatives also participated in Departmental hearings for the Leon and Trinity River watersheds (Tex.).

On the Irons Fork Experimental Forest, construction of permanent improvements to provide work facilities and to render study areas accessible was the main activity. Developments included: (1) construction of a caretaker's residence; (2) electric power, water supply, and sewage-disposal plants; (3) fences and roads at the headquarters site; and (4) construction of a motorway and many miles of foot trails to open up the area for observations.

In June 1937 were started observations of surface run-off from 32 pairs of study plots distributed in 4 main forest cover-types and at 2 altitudinal zones in the Hoover Creek and Nesbitt Creek watersheds. The purpose of this study is to determine whether surface run-off (overland flow) is an important contributing factor to the peak discharge of the Ouachita streams and, if so, in what cover types or on what physiographic sites these contributions originate. From June to the end of the year, mean run-off from the 64 plots was small, averaging only a little over 2 percent of the rainfall fo the heaviest storm, in which 3.92 inches of rain fell. The preliminary indications, although inconclusive, seem to bear out prior reasoning that much of the water reaching streams during periods of peak flow is not contributed as surface flow but probably is chargeable to a great extent to shallow groundwater drainage through talus and highly pervious mantle rock. Confirmation of this awaits further observations and analysis of stream hydrographs and rainfall records.

Four stream-gaging stations in Hoover and Nesbitt Creeks were put in operation early in 1937. These are located at the outlet of mountainous watershed units, each approximately 150 acres in area, on which are distributed 75 standard rain gages and 2 rain-recording instruments. During the year, 10 observation wells were put down in valley-fill material immediately adjacent to the gaging stations. The continuous records of water-table fluctuations, which will be obtained at each location, are expected to shed much light on the question of whether there is a rapid movement of ground water through soil and rock materials; if so, this will provide a logical explanation for the sharp and excessive stream rises that occur almost simultaneously with the rains.

At Holly Springs several new water-cycle studies were started during the year. One of these aims to ascertain the effect of land-clearing practices on the flow of a perennial spring. The unit under study consists of a forested catchment area surrounding a hillside spring which during several years has been observed to undergo negligible fluctuations in flow. After a preliminary observation period of about 2 years, the area will be cleared of trees and put in cultivation with a view to determining what effect this has on the flow of the spring. Another study aims at determining the extent to which reforestation measures reduce storm run-off from natural drainage units. This study, which augments one started in 1932 and still in progress, involved the installation of Parshall flumes and recorders to measure run-off from 4 small watersheds in various stages of recovery from prior denudation.

The downward penetration of rainfall through a typical forest soil was also observed throughout the year, before and after rains. Rainfall totaled about 48 inches for the year, or only about 4 inches below the 48-year average. Moisture determinations made in late November, when the soils contained a minimum of moisture, indicate that it would require at least 20 inches of rainfall to bring soil moisture in this profile up to field capacity. These preliminary data show the great potential storage capacity provided by deep, pervious soils such as these. Furthermore, they take on special significance when one considers that whenever these soils are protected by a good forest cover they are capable of absorbing virtually all of the rainfall from even the heaviest storms. Hence in the instance just cited, at least 20 inches of rainfall, or almost half of the annual precipitation, would not reach streams through either overland flow or ground-water drainage, if it fell on this particular forested area following the period of observation.

First-year results from a comprehensive roadbank-fixation study at Holly Springs, started in 1936 and involving establishment of 374 test plots on 2,300 linear feet of roadbank, indicate that: (1) Bermuda grass sods produced a much better protective cover than did seed mixtures; (2) a specially devised method of preparing and planting roadbanks resulted in a denser and more effective cover than the usual method of planting in contour trenches; (3) even a light protective cover of brush and litter inhibited establishment and growth of Bermuda grass and appeared to have a somewhat adverse effect on the establishment of other plant species used in the tests. The preliminary results also indicate that several of the treatments employed are outstandingly better than any observed to date, considering the simplicity of the details of establishment and the extremely poor sites on which the treatments were tested.

Plans for 1938

Under the flood-control surveys project, preliminary examinations will be made of the Yazoo, Tombigbee, and Ouachita River drainage basins, for which the Station has primary responsibility; other bureaus will be assisted in similar studies for the Sabine, Neches, Colorado, Red, Arkansas, and Apalachicola River watersheds.

Under the water-cycle project the present studies at Irons Fork will be continued, with particular emphasis on developing discharge-rate curves for the 4 gaging stations and on maintaining an unbroken record of stream hydrographs, water-table observations, and rainfall records for the Hoover Creek and Nesbitt Creek drainage units. Data on surface run-off will be augmented by a few additional plot installations in foothill and upper valley cover-types. A working plan will be prepared and preliminary work started on a litter study to determine the character and rainfall-retaining capacity of representative forest-litter types. Additional stream-gaging stations will be established and the present ones improved, if emergency funds are continued. At Holly Springs, at least 4 more watershed units will be brought under observation in the run-off study. Also soil-moisture and rainfall-penetration observations will be continued for various soils and cover conditions.

The watershed-improvement project will be expanded with the new studies being concentrated on the Irons Fork Experimental Forest. An analysis of watershed-improvement problems in the Ouachita region will be completed, a working plan drawn up, and exploratory trials made of forest-engineering measures designed to retard run-off and reduce peak discharge of headwater streams At Holly Springs the previously established roadbank-fixation trials will be completed, and additional tests will be started in May (1938) to determine the minimum amount of topsoil dressing required, the optimum number and types of sods in establishing the outstanding species (Bermuda grass), the best mixture and sowing rate for several other promising species, and the minimum requirements in revegetating road fills. Another study will be started to test the effectiveness of soil-pits and sand-checks as substitutes for check-dams in controlling special types of gullies. Also a problem analysis of watershed-improvement problems in the scrub woodlands of central Texas and Oklahoma will be made, if funds and personnel permit.

FOREST ECONOMICS

PRIVATE-FORESTRY INVESTIGATIONS

The purpose of private-forestry investigations is to develop for southern forests improved methods of management that are economically sound and technically desirable from the standpoint of land use. During 1937, efforts were concentrated on the Crossett Experimental Forest, where improvement cuttings, removing both pine and hardwood trees unsuitable for present or future sawlogs, were made on five 40-acre plots. A careful study of costs and returns showed that a margin of about 75¢ per standard cord for pine and 25¢ for hardwoods remained for stumpage, profit, and interest. Thinnings of various degrees of intensity in dense old-field pole stands of pine yielded a margin of slightly over $1 per cord for stumpage, profit, and interest. The cost of producing a cord of pulpwood from 6-inch trees was about twice that from 10-inch trees. Although these studies were made under commercial practices, they resulted in net incomes with which the private owner could meet taxes and other carrying charges on stands under sawlog size.

The field data from the tractor-logging study, made during 1936, were analyzed and correlated, and a preliminary report was completed. This study shows that logging costs per M board feet for 12-inch trees are about three times those for 24-inch trees. Compared with truck logging, tractors evidently are less economical, except for very short hauls.

While past studies have shown that selective timber management was profitable, the effect upon the yields, costs, incomes, and profits of length of cutting cycle, amount of cut, and density of residual stand have not yet been studied and correlated. For this purpose, 26 forties have been set aside on the Crossett Experimental Forest, and 100-percent inventories of all trees 4 inches d.b.h. and above have been made for each. Certain forties will be cut each year, following definite regulations, and all yields, costs, incomes, and profits will be recorded. Several hundred individual trees growing under various stand conditions have been studied; and taper diagrams and utilization charts, showing log grades and pulpwood, have been constructed in an attempt to measure the effects of various environmental factors on growth in volume and quality.

During 1937, the Crossett Experimental Forest and the holdings of the Crossett Lumber Company were shown, as examples of improved methods of cutting and forest management, to hundreds of visitors, including foresters from many parts of the world, lumbermen, pulpmill owners, and others. Occasional Papers 70 ("Profitable management of shortleaf and loblolly pine for sustained yield") and 71 ("Pulpwood production studies in shortleaf-loblolly pine stands") were issued on the basis of findings at Crossett.

Plans for 1938

1. Methods of cutting shortleaf and loblolly pine under a selection system will be studied at Crossett on 7 of the 26 forties set aside for this study, using 4 different cutting cycles: 1 year, 3 years, 6 years, and 9 years. The amount of cut will be regulated so as not to exceed the amount that the reserved stand can restore by growth during the ensuing cutting cycle. In fact, only in the best-stocked stands will the full amount of the growth be cut; in the poor stands only half of the growth will be cut, and the other half will be reserved and added to the growing stock. The cut will be made in all diameter-classes and will remove the poorer trees, reserving the thrifty clear-stemmed trees for further growth.

2. Improvement cuttings will be continued, selecting first those forties which will be the last to receive their original cuts under the "methods-of-cutting" study, and including all forties except those on which harvest cuts for sawtimber will be made within 3 years.

3. Thinnings will be continued in all unthinned old-field pine stands, removing timber of merchantable size for pulpwood, posts, or other products. All costs and returns will be kept.

4. The study of the effects of density, competition, and other factors on volume and quality growth will be continued, including the analysis

and correlation of data that apply to 600 trees at Crossett. Studies of forecasting growth of stands will also be continued.

5. Reports will be prepared on (a) selective cutting in second-growth shortleaf-loblolly pine and (b) the costs of tractor logging in southern pines.

6. The results of previous field investigations on timber management and integrated utilization in the naval stores region will be reviewed and prepared for publication.

NEW PUBLIC DOMAIN

The principal activity in the New Public Domain project during 1937 was a study of taxation of forest land and timber in the Yazoo River Delta of Mississippi. This study was undertaken in order to define the objection raised by local land owners that the private practice of forestry was impossible, owing to the high taxes levied for government, levee, and drainage purposes. Cooperation was secured from the Delta Chamber of Commerce, the Mississippi State Tax Commission, the Mississippi State Planning Commission, and the Land Planning Specialist of what was then called the Resettlement Administration.

Field work was limited (a) to 5 representative counties of the Yazoo area, (b) within the 5 counties to those public-land-survey townships which were 50 percent or more forested, and (c) within the said townships to properties having a gross area of 250 acres or more. The 5 counties studied were (from north to south): Tunica, Coahoma, Quitman, Washington, and Issaquena. A rough draft of the report has been completed.

Preliminary analyses of these data are already showing some interesting results, one of which indicates that the present system of rural-land classification for taxation purposes in Mississippi has in large measure defeated the very purpose for which it was created. The Mississippi system, as it is now operated, has one distinct disadvantage over non-classification of property in that it tends to "freeze" the assessed values of land in each of the three legally recognized land-use classes at a given figure per acre in each county, irrespective of location, condition, income-producing capacity, or any other factor affecting the actual sale value of the property.

Another interesting point brought out by the study is the very marked reduction in the area held by the State of Mississippi for non-payment of taxes—its "New Public Domain." Owing to the large cotton crop of 1936, coupled with the high price obtainable for the long-staple Delta cotton, and also no doubt owing to Federal benefit payments, the area held by the State under tax title has been very markedly reduced through purchases under patent title from the State. While no measure of the total reduction for the Delta as a whole could be obtained, in the counties studied it is estimated that the area in State title was reduced 30 to 60 percent, and in Washington County about 85 percent, from the area so held as of January 1, 1936.

An analysis of the area in State title as of January 1, 1936, in four of the five counties, shows that about 82 percent of the total area was cutover forest land, the percentages ranging from 72 percent in Issaquena, the most forested county, to 94 percent in Washington, the least forested county. Crop land made up only 3 percent of the total forfeited area, timbered land 6-1/2 percent, and land of unknown classification, 8 percent. Most of the forfeited areas, particularly those which are cut-over forest lands, lie within drainage districts where high taxes make the holding of such lands in private ownership highly unprofitable. A concomitant cause for the low percentage of timbered land in State ownership is the fact that merchantable timber is generally removed by the original owner prior to forfeiture of title.

Among the tax items which have caused widespread forfeiture of forest land for unpaid taxes, and likewise have prevented the adoption of good forestry practices by timber owners, two are outstanding: (1) the high taxes levied for drainage purposes, and (2) the multiplicity of overlapping taxing districts, which subjects certain properties to such a pyramided series of levies that the total tax charge becomes confiscatory. Preliminary analysis of the relation of income-producing capacity of the forests to the total tax charge against them, indicates that in the Delta many of the forest lands bearing merchantable timber can earn the taxes of 20-40¢ an acre levied for ordinary governmental purposes and still be operated at a profit, particularly if they lie on the batture (i.e., between the levees and the river); but when such lands lie within the drainage districts, where the tax for drainage purposes alone may run from 50¢ to nearly $3 per acre per year, or in two or more overlapping special road or school districts, practice of good forestry under current conditions would appear to be economically impossible. Further conclusions of this study and recommendations based thereon will be presented in the final report to be completed in 1938.

Plans for 1938

Plans for 1938 call for a study in Oklahoma to determine the location, area, and assessed value of lands forfeited, or eligible for forfeiture, to county title. This study will be limited to one or two counties in each of the major forest and grazing regions of the state, and will be undertaken to provide data for the state concerning its qualifications to acquire state forests under the Fulmer Act.

FOREST SURVEY

The Forest Survey of the Deep South was started in 1930. It is part of the nation-wide survey authorized by the McSweeney-McNary Act of 1928 and includes an inventory of forest lands and forest resources, a study of rates of growth and depletion, and an investigation of present and probable future requirements. Its purpose is to supply information needed for the formulation of policies of forest-land utilization. By the end of 1936, field work had been completed on 215 million acres; and the computation, interpretation, and publication of results was well under way. During 1937, field work on 12 million acres in the east Texas post-oak belt was completed, leaving to be covered 20 million acres of additional area in Texas and Oklahoma post oak and cedar brakes.

The following table shows total land area, forest-land area, and saw-timber and cordwood volumes (sound trees only) for an area of 213 million acres, including all the states of Alabama, Florida, Georgia, Louisiana, and

Mississippi, and the following parts of states: the pine belt of east Texas and southeast Oklahoma, all of Arkansas except the Ozark Plateau in the northwest part of the state, the southwest quarter of South Carolina, and the portions of Missouri, Kentucky, and Tennessee that lie in the Mississippi River Delta.

Acreage and volume data for the principal forest regions of the Deep South

	Region				Total all regions
	Pine-hdwds. west of Miss. River	Pine-hdwds. east of Miss. River	Naval stores region	Delta of the Miss. River	
	Millions of acres				
Area					
Forest	31.4	36.0	44.5	13.5	125.4
Nonforest	16.9	33.4	18.8	18.8	87.9
Total	48.3	69.4	63.3	32.3	213.3
	Billions of board feet				
Bd.-ft. volume 1/					
Pines	50.3	54.0	41.8	1.1	147.2
Hardwoods 2/	29.0	30.2	24.5	33.0	116.7
Total	79.3	84.2	66.3	34.1	263.9
	Millions of cords				
Cordwood volumes 3/					
Pines	182.3	189.7	168.5	3.8	544.3
Hardwoods 2/	154.2	168.5	130.5	136.9	590.1
Total	336.5	358.2	299.0	140.7	1,134.4

1/ International 1/4-inch rule.
2/ Cypress is included with hardwoods.
3/ Includes sawtimber volume, volume in trees under sawlog size, and volume in tops of sawlog-size pines.

It is of interest that forest area makes up 58.8 percent of the total land area; also that in cordwood volume, pines make up 48 percent of the volume and hardwoods 52 percent. In the Delta region, over 97 percent of the cordage is hardwood; while in the remainder of the territory, pines make up 54.4 percent and hardwoods 45.6 percent.

The average sawtimber stand per acre of forest land, including all conditions from clear-cut to old growth, has been computed for each unit of the four regions in the South. The weighted average stand per acre of sawtimber for each of these regions is a follows: pine-hardwood (west) 2,530 ft. b.m., pine-hardwood (east) 2,341 ft. b.m., naval stores region 1,502 ft. b.m., and the Mississippi Delta region 2,528 ft. b.m. It is interesting to note that in three of the pine units the average stand per acre slightly exceeds 3,000 board feet (lumber tally). These units are Arkansas Unit #3 (southwest Ark.), Louisiana Unit #5 (the adjacent unit in northwest La.), and South Carolina Unit #1 (in southwest S. C.). In each of these units pines make up approximately three-fifths of the total sawtimber volume and hardwoods two-fifths.

An enumeration of the number of sawmills in the area covered by the table previously given, shows that there was a total of 8,112 active mills in this area in 1934, of which 6,713 are classified as pine mills, 1,352 as hardwood mills, and 47 as cypress mills. Small mills (19 M bd. ft. and under daily capacity) comprise 92 percent of all pine mills.

It is a generally accepted fact that large mills are gradually decreasing in number and that small mills are becoming increasingly important in lumber production. In 1934 small mills produced 47 percent of the pine lumber cut. In logging, steam skidders and logging railroads are being replaced by gas skidders, tractors, and motor trucks. These trends and changes in logging and manufacturing processes and in size and number of mills can be recorded, with any degree of accuracy, only by resurveys at regular intervals.

The expansion of the pulp industry in the South continued into 1937 but came to a halt by the middle of the year; no new mills have been announced since August. Within the territory of the Southern Forest Survey, the new mills which are now operating or under construction will have increased the total number of pulp mills approximately 60 percent over the number of operating mills in 1935, and by the end of 1938 the installed capacity of pulp mills will be nearly double that of 1935.

The advent of these new pulp mills, by introducing greater competition among wood-using industries for raw materials, is bringing increased interest in forest-land ownership and forest management. There has been a "boom" in the purchase of forest lands to be put under management; it is roughly estimated that between 4 and 5 million acres are now in pulp-mill ownership, of which over 3 million acres have been acquired in the last 3 years. The new markets which pulp mills provide for low-grade material and small trees offer greater opportunities than previously existed for making profit from thinnings and improvement cuttings and for the practice of integrated utilization, with a reduction in the turn-over time in forest investments.

Certainly, this new interest in, and these added opportunities for, private forest management will have an effect in improving the outlook for the future; but only time and a resurvey will tell whether the change in attitude and practice will be sufficient to offset the growing drain on forest resources resulting from the intensification of forest-utilization activity.

A continuing project, which was organized during 1937 to determine currently by Survey units the year-to-year status of forest industries and the character and volume of the drain on the growing stock, is well under way. It involves considerable field work, as it is necessary to contact directly and periodically the various industries, in order to keep up with the rapidly changing developments.

Data compiled from the field contacts will be combined with computed figures for growth each year, in order to determine the corrections to be applied to bring forward the original inventories of growing stock. It is believed that such a system will give reasonably accurate results for a limited number of years. For numerous reasons, however, this system of perpetual inventory is subject to increasing errors as the years go by, for errors are likely to be cumulative rather than compensating. These difficulties would not be so serious in a region where industry is settled and forest management and cutting practices well stabilized. In the South, however, due to the changes which will inevitably follow the advent of new uses, new industry alignments, new logging practices, and the increased interest in forest ownership and sustained-yield management, the problem rapidly grows more complex, and it becomes increasingly evident that only by a periodic resurvey in the field can accurate inventories of forest resources and accurate data on balance of growth and drain be kept up to date. In critical areas such as the naval stores region it seems imperative that a resurvey get under way not later than 1940, if we are to satisfy the needs of industry and public agencies for accurate, up-to-date knowledge of the forest situation.

COOPERATING AGENCIES

BUREAU OF PLANT INDUSTRY

Forest Pathology

The brown-spot needle disease of longleaf pine continued as the main subject of investigation. Control of the brown-spot by occasional spraying with fungicides appears to be a reasonably satisfactory method. In a longleaf pine plantation in west Florida, where the disease had been checked by spraying nine times in four seasons (1933-36), there was six times more disease on the foliage of unsprayed seedlings than on the sprayed. In southeast Louisiana, longleaf seedlings treated eleven times in five seasons (1931-35) averaged 8 feet tall in their seventh season in the field. The height of unsprayed seedlings in alternating rows averaged 8 inches. On an adjacent area, planted seedlings were divided into three lots. The first lot was sprayed four times during the first season in the field; the second received six treatments during two seasons; the third, eight in three seasons. Treatments were discontinued thereafter. At the end of the fourth season, the average height of the three groups of seedlings was 4, 10, and 11 inches, respectively.

A study of the spread of the disease into an area of natural reproduction, following a single 40-acre fire in Feb. 1934, indicated that the effect of that fire in reducing infection was no longer apparent at the end of the third winter after the fire.

Germination tests of spores of the brown-spot fungus were conducted in the laboratory at room temperature. With 35 spores from cultures, the time required for germination varied from 14 to 29 hours. Similarly, with 33 spores from needles the germination period varied from 16 to 42 hours. Two attempts at artificial inoculation of healthy seedlings gave negative results.

A study of canker-forming rusts, *Cronartium cerebrum* and *C.*

fusiforme, was initiated as a major project. Most of the pathological research on these rusts has hitherto dealt with mycological studies and host relationships. Fundamental studies of this type, however, have given little factual data of value in forest management. Determination of the effect of these diseases on mortality and growth of southern pines is requisite to a correct appraisal of their economic importance, and a systematic study of the diseases in relation to forest-management practices may reveal some method of control. With these objectives in mind, extensive surveys were made in Louisiana, Mississippi, and Alabama to locate suitable areas for study.

Following the discovery of cankered seedlings in a nursery in south Mississippi, a survey of ten pine-tree nurseries in the Gulf region was made to determine the extent and amount of nursery infection. Observations on these diseases in nurseries, in plantations, and in natural stands of slash and loblolly pines indicate their increasing importance and suggest a causal relationship between forest-management practices and type of infection.

Plans for 1938

1. Experimental work established on national and experimental forests in the region will be continued. The pathogenicity of the fungus causing the brown-spot should be demonstrated, and a taxonomic study of the organism made.

2. Annual examination of permanent sample plots will be made to determine what effect the rust diseases have on mortality and rate of growth. Some phases of the problem well worth considerable study are: (1) dissemination of sporidia from oak to pine; (2) relative susceptibility of different species of oak; and (3) epidemiology of the disease in relationship to weather.

Forest-Products Pathology

The commercial stain-preventative chemicals, and a few that are being developed commercially or apparently are suitable for such development, were retested in seven commercial test piles. There was no indication that any of the chemicals would differ much from each other in effectiveness under usual commercial conditions, and no change in previous recommendations seems needed.

Observations made at mills using sodium pentachlorophenolate as a stain preventative show that the same care is needed in using this chemical as with the other chlorinated phenols, if skin injury to workmen is to be prevented.

Pine lumber dipped in Lignasan and Dowicide P in two tests remained bright when bulk-piled for 2 and 4 weeks and also when it was subsequently dried in regular air-seasoning piles. Although the air-seasoning conditions were not severe, the tests indicate that treated pine can be bulk-piled safely for short periods before seasoning. Such a practice, however, is not to be recommended if prompt seasoning is at all feasible.

Extensive isolations from stained pine and hardwoods disclosed that: (1) the same fungi are associated with log and yard stain in both pine and hardwoods; (2) although many staining fungi were isolated, the major stain is caused by 7 species, 3 largely limited to pine, 2 to hardwoods, and 2 on both; and (3) none of the major staining fungi are entirely limited to particular seasons, although a few are of much more importance during either the warmer or cooler seasons.

Field and laboratory tests showed that stain in pine and hardwood logs will spread by the extension of stain already in the wood while yard-seasoning the lumber cut from them. The extent of the spread seemed to depend primarily on the rate of drying and was considerable under poor drying conditions. If the lumber was chemically treated, the surface spread was negligible, but interior spread was exposed on surfacing.

Data on stain dissemination, still inconclusive, show that mill machinery, air, and insects are involved, and point to insects as the major agent.

Plans for 1938

1. Studies of the flora causing stain will be continued and extended to the eastern and northern limits of the region.

2. A study will be started of (a) the factors responsible for seasonal variation; (b) source of inoculum; and (c) the means of dissemination of staining flora.

3. Investigation will be started of the factors responsible for the occasional failure of stain preventatives under commercial conditions.

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Forest-Tree Insects

Apparently the only serious forest-insect problem in the Gulf States at the present time is provided by the leaf-cutting ant, Atta texana, which in certain parts of Louisiana and Texas is a hazard to reforestation, since it kills not only trees in plantations but also natural reproduction. Our experiments have definitely shown that by treating the nests with carbon bisulphide before planting, the insect can be exterminated; it probably will not reinfest the area treated before the plants have reached an age when they will no longer be seriously damaged by the ant. A detailed plan of procedure has been prepared for use in the region, and the results of control work will be carefully checked.

There is always a possibility that bark beetles will become epidemic, and careful watch is being kept especially during periods of drought, but in this region such a possibility is slight.

Plans for silvicultural and chemical experiments to control the tipmoth have been formulated, and experimental plantations on the Kisatchie National Forest have been established. To discover the relative effectiveness of the methods to be tried, growth measurements will have to be made for at least 5 years.

Forest-Nursery Insects

Damage by nursery insects in this region is comparatively slight. It is believed that the high soil temperatures combined with high humidity account for the small amount of damage, particularly by white grubs. To determine the status of these insects, contacts are maintained with 40 forest nurseries, where 100 million seedlings are grown each year.

Forest-Products Insects

A series of tests of soil poisons to protect buildings from attack by termites has been enlarged to include 50 buildings treated by commercial termite-control operators. In addition, a total of 25 buildings will be treated under direct supervision of the Bureau of Entomology and Plant Quarantine, with the soil poisons believed to be most effective. The data obtained on relative effectiveness and cost of these chemicals will be of great value. Considerable progress has been made on this project, which at present is receiving priority.

A large-scale test on protecting hardwood timber from attack by powder-post beetles, under way at Vicksburg, Miss., has to date given data on the effectiveness of various chemical dips in protecting lumber from the attacks of these beetles. It is hoped to complete this experiment in 1938 and to obtain data on the effectiveness of 136 different chemical dips.

Experiments have shown that diphenyl will protect green logs fairly well against ambrosia beetles. Also, spraying the lower portion of piles of green lumber with this chemical has given fairly good protection against these beetles.

Wood Preservatives and Chemical Poisons for Fibre Boards

In cooperation with the Forest Products Laboratory and several chemical companies, a series of tests of over 110 chemical wood-preservatives is under way to determine their effectiveness in protecting wood from termites and decay.

In cooperation with the manufacturers of fibre boards, a large series of impregnated boards is under test to determine the protection from attack by termites afforded by the chemicals, which are placed in the boards during manufacture.

These large-scale tests will run over many years.

Plans for 1938

Current work will be continued.

BUREAU OF BIOLOGICAL SURVEY

Bird and Rodent Damage

The effect of birds on longleaf pine reproduction was again the major problem of the year. Previous studies had demonstrated fairly conclusively that birds, and not rodents, were responsible for much of the loss to both seed and seedlings, but as conditions vary from year to year it was considered advisable to check closely the losses that occurred over a period of several years. The fall and early winter of 1936-37 was characterized by an almost total lack of longleaf pine seed, and as an apparent result there was a conspicuous scarcity of such seed-eating birds as the meadowlark and the blackbirds. On the assumption that, with the elimination of birds as a factor, there should be relatively little loss of longleaf pine reproduction, sample plots were established on which seed was sown in late Dec. 1936, and a careful check of the germination of the seed and survival of the seedlings was made 2 months later. On these plots the only attempt made to protect the seed was by utilizing methods that might be employed in direct-seeding operations on burned or cut-over areas, viz., broadcasting, mulching, and drilling to a depth of 0.25 inch. Results obtained showed conclusively the dependence certain birds must place on pine seed as a winter-food supply. One plot showed a survival, as far as birds were concerned, of practically 100 percent, while on two others the loss was negligible when compared with the survival on similar plots established the preceding year.

The late fall and early winter of 1937-38 were much like those of 1935 in that the cone crop was as good as, or slightly better than, that of the average year. Observations in the field, and the analysis of stomach contents, again showed that meadowlarks, blackbirds, quail, and mourning doves eat large quantities of pine seed, although that season probably more pine seed was eaten than usual because throughout the first half of December the weather was abnormally cold, and insects, which were correspondingly inactive, were less available as food.

Intensive trapping at intervals throughout 1937 again showed a great scarcity of rodents on cut-over longleaf pine lands. There was a possibility, when this scarcity was found to exist in 1935, that rodent numbers were then at a low ebb, since it is now recognized that both rats and mice have definite cycles of abundance and scarcity. As this is the third year that such a condition has existed, however, it would appear that the normal population of rodents in the Gulf Coast region is decidedly meager.

Plans for 1938

This study will be continued at irregular intervals for at least another year, but it is anticipated that the results will be the same.

Distributional Studies

Since the basis for all biological field investigations must necessarily involve a thorough knowledge of the bird and mammal life of the region in which detailed studies are being undertaken, distributional studies were carried on throughout 1937 as opportunity offered. A preliminary survey was made of the bird and mammal life of Oklahoma, and limited field work was also carried on in Georgia, Florida, Louisiana, and Texas. In this connection a certain amount of collecting was necessary to determine the various geographic races occurring in this region, and much of this material is now incorporated in the Natural History Collection of the Station at the Harrison Experimental Forest near Saucier, Miss. At the present time this collection, which consists of 162 bird skins and 58 mammal skins, is fairly representative of the wild life of the Gulf Coast region.

Plans for 1938

Current work will be continued.

PUBLICATIONS

January 1, 1937 - December 31, 1937

Bond, W. E.	- The work of the Southern Forest Experiment Station and its application to private forest management. Address delivered before Second Annual Cooperators' Meeting, Little Rock, Ark., on July 6, 1937. Occasional Paper No. 67, 6 pp. August 23, 1937.
______ Wahlenberg, W. G., and Kirkland, Burt P.	- Profitable management of shortleaf and loblolly pine for sustained yield. Occasional Paper No. 70, 37 pp., illus. Nov. 30, 1937. Southern Lumberman 155 (1961): 129-140, illus. Dec. 15, 1937.
Bull, Henry	- Tools and labor requirements for pruning longleaf pine. Jour. Forestry 35 (4): 359-364. Apr. 1937.
Burleigh, T. D.	- Bird life on the North Carolina coast. The Auk, pp. 452-460. Oct. 1937.
______	- The birds of Athens, Clarke Co., Georgia. The Oriole (Quarterly of the Ga. Ornithol. Soc.) June and Sept. 1937.
Craig, Ronald B., and Hall, Orville J.	- Tax delinquency of forest land in Arkansas, 1932-1933. Arkansas Agric. Exper. Sta. Bull. No. 340, 70 pp., illus. June 1937.
Demmon, E. L.	- Economics of our southern forests. Address before Rollins Econ. Conference, Rollins College, Winter Park, Fla., Feb. 2, 1937. Occasional Paper No. 59, 10 pp. Feb. 23, 1937.
______	- Forests in the economy of the South. Southern Economic Jour. 3 (4): 369-380. Apr. 1937.
______	- The opportunity for forestry in Louisiana's agricultural program. Occasional Paper No. 63, 8 pp. June 11, 1937.
______	- The opportunity for forestry in Mississippi's agricultural program. Address before the Farm Chemurgic Conference, Jackson, Miss., Apr. 13, 1937. [Mimeographed by Miss. State Extension Service.] 7 pp.
Eldredge, I. F.	- A preview of the Forest Survey's findings in the Lower South. Southern Lumberman 155 (1961): 123-128, illus. Dec. 15, 1937.
______	- Paper, pulp, poles, and preservation. Address before New Orleans Convention of the American Wood Preservers Assoc., Jan. 27, 1937. Electrical World, p. 61, Apr. 10, 1937.

Eldredge, I. F. - Tar heels of the piney woods. American Forests 43 (2): 63-68, 93, illus. Feb. 1937. Also in: Gamble's Internat. Naval Stores Year Book for 1937-38, pp. 160-166, illus. 1937.

______________ - The forest situation in the Lower South. Souvenir Program TAPPI Fall Convention (Technical Association of the Pulp and Paper Industry). Reprint of Tech. Assoc. Papers Section, pp. 1-10. 1937.

______________ and Ineson, F. A. - The supply of second-growth naval-stores timber. Gamble's Internat. Naval Stores Year Book for 1937-38, pp. 150-154, illus. 1937.

Forest Survey Staff - Sawtimber and cordwood volumes in southwest Louisiana. Forest Survey Release No. 23, 8 pp., illus. Jan. 4, 1937.

__________________ - Sawtimber and cordwood volumes in central and southwestern Mississippi. Forest Survey Release No. 24, 9 pp., illus. Mar. 13, 1937.

__________________ - Sawmills in the Lower South. Forest Survey Release No. 25, 7 pp., illus. May 3, 1937.

__________________ - Volumes on an average acre in the various units of the pine-hardwood region west of the Mississippi. Forest Survey Release No. 26, 29 pp., illus. July 12, 1937.

__________________ - Forest resources of southwest Arkansas. Forest Survey Release No. 27, 21 pp., illus. July 31, 1937.

__________________ - Pole and pile timber in the pine-hardwood region - west. Forest Survey Release No. 28, 11 pp., illus. Sept. 25, 1937.

__________________ - Volumes on average acres in the principal units of the naval stores region. Forest Survey Release No. 29, 17 pp., illus. Oct. 30, 1937.

Harper, V. L. - Fire research in the Lower South. Fire Control Notes, pp. 229-237. Aug. 9, 1937.

____________ - The effect of turpentining on the growth of longleaf and slash pine. Occasional Paper No. 64, 4 pp. June 21, 1937. Also in: Naval Stores Rev. 47 (21): 16-17. Aug. 21, 1937.

____________ and Bickford, C. A. - The slash pine, a "multiple purpose" valuable tree for the Southeast. Gamble's Internat. Naval Stores Year Book for 1937-38, pp. 144-146, illus. 1937.

Ineson, F. A.	- Forest resources of the Lower South. Souvenir Program TAPPI Fall Convention (Technical Association of the Pulp and Paper Industry). Reprints of Tech. Assoc. Papers Section, pp. 27, 33, illus. 1937.
———	- Review of: "Our natural resources and their conservation," by A. E. Parkins and J. R. Whitaker. Jour. Forestry 35 (7): 697-699. July 1937.
Lamb, Howard	- Rust canker diseases of southern pines. Occasional Paper No. 72, 7 pp., illus. Dec. 27, 1937.
Lemieux, F. J.	- Management and utilization of southern hardwoods. Southern Lumberman 154 (1941): 34, 36, 38, illus. Feb. 15, 1937.
Liefeld, T. A.	- Does rain wash gum out of turpentine cups? Naval Stores Rev. 47 (29): 8. Oct. 16, 1937.
———	- Naval stores yields from bark-bars. Occasional Paper No. 61, 8 pp., illus. May 17, 1937; Naval Stores Rev. 47 (15): 8, 10. July 10, 1937; also published under title: "Study of naval stores yields secured by working bark-bars." Jour. Forestry 35 (11): 1068-1070. Nov. 1937.
Meginnis, H. G.	- Sulphuric acid treatment to increase germination of black locust seed. U. S. Dept. Agr. Circ. No. 453, 35 pp., illus. Nov. 1937.
Nelson, R. W.	- Analysis of report of forest taxation inquiry. Southern Pine Forestry Notes 29, 1 p. 1937.
———	- Solving the forest tax problem. American Lumberman 3099: 70. May 8, 1937; Naval Stores Rev. 46 (40): 10. Jan. 2, 1937; Southern Lumberman 154 (1943): 34. Mar. 15, 1937.
Osborne, J. G.	- Pulpwood and forest fires. The Paper Industry 19 (6): 661-664, illus. Sept. 1937.
——— and Harper, V. L.	- The effect of seedbed preparation on first-year establishment of longleaf and slash pine. Jour. Forestry 35 (1): 63-68. Jan. 1937.
Pease, Truman E.	- Dull chipping tools cause fifteen percent loss in gum yield. Occasional Paper No. 60, 3 pp., illus. Apr. 10, 1937.
Pessin, L. J.	- Moisture requirements of longleaf and slash pine seedlings. Planting Quarterly 6 (3): 24-26. July 1937.
———	- The effect of nutrient deficiency on the growth of longleaf pine seedlings. Occasional Paper No. 65, 7 pp., illus. July 19, 1937.

Raber, Oran - Water utilization by trees, with special reference to the economic forest species of the north temperate zone. U. S. Dept. Agr. Misc. Pub. No. 257, 97 pp. June 1937.

Reynolds, R. R. - Don't log small trees. Progressive Farmer and Southern Ruralist. Dec. 1937.

______ - Factors for converting log and tree volumes or values from one common scale to another. Occasional Paper No. 68, 4 pp. Sept. 15, 1937.

______ - Forest management in shortleaf-loblolly pine regions of the South. Ames Forester 25: 27-33, illus. 1937.

______ - Pulpwood production studies in shortleaf-loblolly pine. Presented before Group #4 Pulpwood Producers' Association Meeting at Crossett, Ark., Nov. 18, 1937. Occasional Paper No. 71, 5 pp. Dec. 4, 1937.

______ - Values in Arkansas wood. Address before the Farm Chemurgic Meeting, Little Rock, Ark., June 28, 1937. Southern Conservationist 1 (6): 14, 21-22. Sept. 1937.

Smith, Harry F., and Rayl, Elsa M. - Gum naval-stores operations of 1934-35 - their size and distribution, and the employment provided by them. Gamble's Internat. Naval Stores Year Book for 1937-38, pp. 155-157. 1937.

Snyder, T. E. - Damage to young pines by a leaf-cutting ant (Atta texana Buckley) in Louisiana. La. Conservation Rev. 6 (1): 14-17, illus. Jan. 1937.

______ and Hunt, Geo. M. - An international termite exposure test. Eighth progress report. 33d Ann. Meeting of American Wood Preservers Assoc., New Orleans, La. 12 pp. Jan. 1937.

Southern Forest Experiment Station - Photographic Folder. 14 pp., illus. 1937.

______ - Southern Forestry Notes No. 18, Aug. 1937.

______ - Southern Forestry Notes No. 19, Oct. 1937.

Stover, W. S. - Rapid growth of hardwoods in the Deep South. Cross Tie Bull. 18 (1): 15-18. Jan. 1937.

Verrall, A. F. - Variation in Fomes igniarius (L.) Gill. Presented at 84th Ann. Meeting of the New Orleans Acad. Sci., March 19, 1937. Minn. Agric. Exper. Sta. Tech. Bull. 117, 41 pp. Apr. 1937.

______ and May, Curtis - A new species of Dothiorella causing die-back of elm. Mycologia 29: 321-324. 1937.

Wahlenberg, W. G. - Pasturing woodland in relation to southern forestry. Delivered at meeting of Assoc. of Southern Agric. Workers, Feb. 3-5, 1937. Jour. Forestry 35 (6): 550-556. June 1937.

Wakeley, Philip C. - Recommendations on forest improvement. U. S. Dept. Agr. Yearbook, 1937, p. 1266. 1937.

______________ - Southern pine seed. Southern Pine Forestry Notes 36, 1937; Naval Stores Rev. 47 (29): 14-15. Oct. 16, 1937

______________ and Chapman, R. A. - A method of studying the factors affecting initial survival in forest plantations. Occasional Paper No. 69, 19 pp., illus. Oct. 11, 1937.

Winters, R. K. - Forest industrial expansion in southeast Texas - possibilities and dangers. Address delivered at Beaumont, Tex., before the Texas Acad. Sci., June 26, 1937. Occasional Paper No. 66, 6 pp., illus. Aug. 9, 1937.

______________ - Method of measuring pulpwood on farm woodlands in southern Mississippi. Southern Conservationist 1 (9): 10, 17. Dec. 1937.

______________ - The forest survey, what can it contribute to State planning in Georgia? Address before Georgia Forestry Assoc., Athens, Ga., May 19, 1937. Proc. 16th Ann. Meeting Ga. Forestry Assoc., pp. 10-15. 1937.

______________ - The place of forests in a land-use program for the South. Address before Assoc. of Southern Agric. Workers, Nashville, Tenn., Feb. 3, 1937. In "Forestry in Relation to Agriculture" (papers delivered before the forestry section of the 38th annual convention of the Assoc. Southern Agric. Workers), pp. 48-56. 1937; Occasional Paper No. 62, 6 pp., illus. June 7, 1937; also published under title: Forests in a land-use program. Jour. Farm Economics 19 (3): 758-763, illus. Aug. 1937.

Unpublished Addresses

Bickford, C. A. - The use of fire in the natural regeneration of longleaf pine. Presented at 84th Ann. Meeting of the New Orleans Acad. Sci. Mar. 19, 1937.

Pessin, L. J. - The water requirements of longleaf and slash pine seedlings. Presented at 84th Ann. Meeting of the New Orleans Acad. Sci., New Orleans, La. Mar. 19, 1937.

Raber, Oran - The role of an arboretum in a civilized community. Radio address over WWL, Feb. 18, 1937.

AGRICULTURAL REFERENCE DEPARTMENT
CLEMSON COLLEGE LIBRARY

SOUTHERN FOREST EXPERIMENT STATION

E. L. Demmon, Director

New Orleans, La.

EIGHTEENTH ANNUAL REPORT

Jan. 1, 1938 - Dec. 31, 1938

CONTENTS

Page

Introduction 1
Current investigations and plans for 1939:
    Forest management.. 3
        Silviculture (pines):
            Harvest cuttings and stand improvement 3
            Silvics 7
        Mensuration 9
        Regeneration.. 10
            Regeneration in Puerto Rico 13
        Fire 13
        Naval stores 15
    Forest survey 16
    Forest economics:
        New public domain 21
        Private forestry 23
    Forest influences 25
    Flood-control surveys 28
  Cooperating agencies:
    Bureau of Plant Industry 29
    Bureau of Entomology and Plant Quarantine 31
    Bureau of Biological Survey 33
Personnel 35
Publications 39
  Unpublished addresses 44

EIGHTEENTH ANNUAL REPORT

of the

SOUTHERN FOREST EXPERIMENT STATION

January 1, 1938 - December 31, 1938

INTRODUCTION

During the last few years, and for the first time in many decades, the South has found itself in the spotlight of sustained national attention. Wherever one goes he will encounter discussion and appraisal of this great section of our country. Its problems, its shortcomings, and its opportunities share alike in the public eye. The Nation, apparently, has only just realized that something is happening in the South and that in this region developments of national significance are ahead.

Truly, events are on the march in the South, where maladjustments of long standing are rapidly forcing far-reaching changes in the traditional pattern of its economy. While the South's human population is increasing, the opportunity for employment in agriculture, its main field for labor, is decreasing. In the lower South particularly, the shrinkage in cotton culture is driving increasingly more people to seek new fields of activity. The South's ports and railroads are suffering for lack of freight tonnage, and almost everywhere throughout the cotton belt agricultural lands are being abandoned and the cash income to farmers is diminishing. Under such conditions, something has had to happen, and so today as never before new opportunities for capital and labor are being sought throughout the region; and new enterprises are following, as in the early years of the West, hard upon the heels of discovery.

It is therefore both fortunate and timely that the Forest Survey of the Southern Station came into action when and as it did, for high among the list of the South's natural resources is its timber wealth. Its forests, which characterize 6 out of 10 acres in the lower South, occupy more land than all other crops combined. Consequently the development and harvesting of timber crops, and the manufacture and distribution of forest products, are of great importance in the solution of the South's economic problems.

The forest inventory of the South (details are given later in this report) shows that while the virgin old-growth timber stands are being rapidly depleted, the second-growth stands that followed on the cut-over lands, despite indifference and abuse, have developed rapidly and today form an extensive growing stock of timber, which if properly cared for and conservatively utilized, will appreciate both in volume and value in the years to come. The Survey data have served to focus the attention of the Nation on the extent, character, and value of this resource; they also indicated the necessity of applying forestry principles to its care and use if it is to serve as a sound basis for the greatly increased forest industries so essential to the future prosperity of the South.

Now, for the first time, we can see the part that forests must play in the future of the South, but we also see that in every forest type and in every phase of forest industry there is immediate need for more research--for more specific knowledge of what to do and how to do it. The territory is a huge one, and within it the forestry problems to be solved are many, varied, and complex. For example, it was found that although 63 percent of the total cordwood volume of all timber in the South was made up of hardwoods and cypress, no research is under way in these types.

In the field of forest economics, involving the all-important financial side of forestry, there is pressing need for greatly increased research and study, if private enterprise, particularly new capital, is to enter a strange field with confidence and safety. Markets, local and foreign, trends in consumption, the interplay of raw-material supply, labor, wages, taxes, and other costs, with risks, profits, and other economic factors, need investigation. More forest-utilization studies are also needed urgently.

In silviculture and forest management, we have hardly more than broken the ground, while the demand for sound knowledge ready for application is increasing constantly as more and more forest land is organized and put under management. A recent survey indicated that over 18 million acres of commercially owned forest land in the South is being managed with the object of continuous production, at least in sufficient quantity for commercial operation.

In the field of forest influences, there is also much to be done. New techniques must be developed to improve watershed cover and to insure management of the southern forests for maximum watershed protection. An even more important need is that for basic research on the complex relationship of forests to stream behavior. The current flood-control surveys of the Department of Agriculture are giving rise to many technical problems which cannot be solved adequately without a well-rounded region-wide program of forest-influences research.

In fire control, the need for more tested information is a universal and crying one. The South to a large degree is modernizing its attitude towards fire protection, but improved techniques are needed. In forests huge investments are being made, for which a greater degree of security is necessary

Furthermore, the Forest Survey itself, which has drawn a clear and convincing picture of our present forest resources and has warned us of the insufficiency of these present resources to meet the future needs of the South, must remain active and continue to function with increasing attention to specific resource problems in critical sections of the South. Only in this way can the basic information concerning our forest wealth be kept up to date and in step with the rapidly changing economic conditions that characterize this particular period.

The South, under the spur of necessity, is striving hard for more forest industries and will be forced before long to draw on its forest resource to the utmost. The soundness and permanency of rapidly expanding forest industries must depend to a very large extent upon greatly increased activity on the part of the Southern Forest Experiment Station, whose function is to carry on adequately the research that must be conducted, if the forests are to play the part in the development of the South that destiny has thrust upon them. This research, which is an essential basis for the scientific practice of forestry, must be increased in volume and in tempo if we are to discharge our obvious responsibilities and promote the full use of the South's forests for timber growing, watershed protection, recreation, and game management.

CURRENT INVESTIGATIONS AND PLANS FOR 1939

FOREST MANAGEMENT

Forest-management research is conducted in five major projects: Silviculture, Mensuration, Regeneration, Fire, and Naval Stores. Progress made during the past year in each of these projects is discussed below.

SILVICULTURE (PINES)

Harvest cuttings and stand improvement

Research in silviculture (literally the culture or handling of the forest) is primarily concerned with determining facts and developing methods for the proper technical handling or operation of the forest. The most important silvicultural problems in the South are concerned with the handling of established stands—how and when to cut them in order to obtain maximum growth and quality, and in the case of mature stands, their natural reproduction. Because of the rapid growth of southern pines and the increasing markets for pulpwood, types of cutting that remove merchantable products receive major attention. These include harvest cuttings in mature stands (involving reproduction) and intermediate or stand-improvement cuttings in younger stands. Second in importance are cuttings and other treatments intended to increase the volume and quality of merchantable products. These include thinnings in very young stands, the cutting or girdling of worthless hardwoods, and pruning.

Station resources are insufficient to work on all the important silvicultural problems in the South, and research is therefore concentrated on a few of the most important problems. Five of these problems and the progress made during 1938 in solving them will be discussed separately.

Improvement cuttings in second-growth pine stands.— The second-growth pine forests of the South usually contain a large proportion of very poor trees—trees that because of undesirable form, quality, condition, growth rate, or species should be removed in order to benefit the growth of better ones. By removing the poor trees in an improvement cutting, the growth formerly put on by both the good and poor ones is now concentrated on the good ones, which have increased space in the stand and therefore grow faster. Regardless of whether the stands will be cut over selectively, producing an all-aged forest, or handled as even-aged stands, improvement cuttings that remove merchantable products constitute a logical first step in management. Information on increased growth following improvement cuttings has been obtained from an experiment established in a second-growth shortleaf-loblolly-hardwood forest near Urania, La., in 1933. In the 5 years from 1933 to 1938, the merchantable board-foot volumes increased 43 and 75 percent on two improved plots, compared with only 32 and 37 percent, respectively, on the unimproved control plots.

Based on actual costs and returns in 1933, the sawlogs and pulpwood removed in the improvement cuttings made net profits of $6.90 and $9.24 per acre, respectively, excluding cost of stumpage (since the operator cut on his own land). These high values are due partly to the low labor costs of 1933 and partly to the fact that the areas adjoined a State highway and were close to a sawmill and a railroad, but net profits would still have been returned with considerably higher labor costs, a less accessible location, and purchased stumpage. The improvement cutting also included the girdling of the larger unmerchantable and worthless hardwoods, and resulted in an increased growth of about one-half cord of pine pulpwood for each man-hour spent in girdling. At 1938 prices and costs, the value of the increased growth approximately balanced the cost of girdling in the first 5 years. In the next few years, the growth on the girdled plots should far outstrip the growth on the ungirdled plots, and the net profit from this improvement operation should rise sharply.

Experimental management plan for the Olustee Experimental Forest. - There has long been a need for tests and demonstrations of different methods of forest management on a rather large scale, including a complete record of costs and returns. The National Forests and certain privately owned forests provide large-scale demonstrations of forest-management practices, but the elements of a systematic experiment, and of the comparison of a variety of methods, objectives, or policies, are lacking in these cases. The National Forests and the managed private forests demonstrate the particular methods and policies of management considered best by those in charge, but a comprehensive test of different silvicultural and management practices is distinctly the responsibility and obligation of research. A comprehensive experimental management plan for the Olustee Experimental Forest was prepared during 1938 to meet this need.

The Olustee, which is the Station's primary experimental forest for the longleaf-slash pine type in the Southeast, is very accessible and receives many visitors. It contains adequate areas of both round and turpentined timber of sufficient size and density for practicable silvicultural operations. Furthermore, this forest is representative of a forest type and region where different methods of management are especially needed because of the many different products that can be produced from both large and small trees. A total of 2,780 acres in the Olustee is included in the management plan: 480 acres on which fire is to be used as a silvicultural tool; 1,950 acres to be managed with only incidental use of fire; and 350 acres in swamps containing mostly cypress and hardwoods. Principal interest at the present time is centered on the second of these areas, which contains both round and turpentined timber. The units of management will be 10-acre compartments, on which a total of 65 different unit treatments will be repeated two to four times each.

As an example of the diversity of treatments or methods of management to be tested, this 1,950-acre block will be taken as an example. The first breakdown is based on the round and turpentined conditions, since these will greatly influence the application and results of management. Within each condition, two forms of forest will be developed separately: an even-aged forest (prevailing at present), and an uneven-aged or selection forest. Within these two forms of forest, three different objectives of management will be followed separately: (1) the production of small-dimension wood products, such as pulpwood, small sawlogs, poles, and piles; (2) the production of gum naval stores as the main crop; and (3) the production of large-dimension high-value wood products, such as large sawlogs, poles, and piles. In general, these three objectives imply rotations of different length. Within each compartment managed for a single objective, however, integrated utilization will be practiced, and each tree will be harvested for the product or products for which it is most valuable. In compartments to be handled as even-aged stands, harvest cuttings will be made at different times, from 3 to 50 years hence. In the new stands that follow these harvest cuttings, different systems and degrees of thinning will be tested. In the compartments to be handled as selection stands, different cutting cycles from 3 to 18 years will be tested. These plans are based on the desire to test as many different kinds, classes, objectives, and degrees of management as are likely to prove successful or desirable, and that can be tested adequately on the available area.

Marking has been done for the first sawlog and pulpwood cuttings, and removal of the sawlogs is already in progress. The trees to be turpentined in 1939 also have been selected.

Survey of commercial pulpwood cuttings.—The rapid expansion of the pulp and paper industry in the South is an unquestioned asset of tremendous value only if the cutting of pulpwood is done in such a way that the forests remain productive. Since pulpwood can be made from very small trees, the pulpwood industry easily can be a menace instead of an asset, unless pulpwood cutting is done conservatively and with an eye to sustained yield rather than to immediate maximum profit. What are the facts? What is the present condition of areas cut over for pulpwood? Are past practices satisfactory, and if not what changes are needed? Considering the rate of expansion of the industry, pertinent questions of this kind need an early answer and cannot await prolonged study. To get the broad facts quickly, therefore, an extensive study of stand conditions following commercial cuttings of southern pine pulpwood was started in 1936. Analysis of the data, obtained on 500 1/10-acre sample plots in Louisiana, Mississippi, Arkansas, Alabama, and Florida, was completed during the past year.

The following generalized facts have come from this study:

1. The bulk of the pulpwood cuttings, which have been made in well-stocked but immature stands, were much too heavy for maximum sustained yield.

2. The diameter growth of individual residual trees has been good, but because of the light residual stand the volume growth per acre has been very low, and no further cutting will be possible on many of the cut-over areas for several decades.

3. Most of the areas examined had not reproduced adequately, owing largely to uncontrolled fires and lack of sufficient seed supply; in some cases concentrated grazing was also a factor.

4. From 50 to 75 percent of the areas examined have burned over at least once since cutting, and many have burned over several times.

5. Owing to heavy cutting, the residual trees were usually small, spindly, and had a low resistance to injury or other adverse conditions, such as fire, insects, wind, and ice storms. Consequently mortality has been high and often exceeded growth during the first 5 years after cutting.

6. Because of the heavy cutting of pines, the residual stands show a strong tendency toward conversion to a hardwood type. This is especially true where the hardwoods originally were numerous, even though only in the understory.

To correct these conditions in future pulpwood cuttings, it is especially necessary to:

1. Provide better and more widespread forest-fire protection, especially immediately following cutting.

2. Sustain and increase the productivity of immature stands by limiting the cut to thinnings and improvement cuttings.

3. Make harvest cuttings in mature stands in such a way that an abundant supply of pine seed is assured; for maximum sustained yield, however, it will be necessary to give attention to many other technical points which cannot be considered here.

Thinnings in second-growth slash pine. - Stands of dense, young even-aged slash pine are becoming increasingly abundant throughout the Southeast as fire protection improves in both scope and efficiency. How to handle these stands is one of the major problems of forest management in the naval stores region—and one that becomes more important with each passing year. Most foresters consider thinnings in such stands to be essential, but few agree on when, how, and how much to thin particular stands for particular purposes. The Station started 3 years ago to collect data to furnish answers to the problem of slash pine thinning by developing a method for estimating the results of different schedules of thinning. This study has been carried to a point where further field data are needed.

Growth and mortality of individual trees in partly cut stands. - Regardless of whether the southern pines are handled principally in selection forests or in even-aged forests, partial or selective cuttings are, and for a long time will continue to be, widely used because of (a) the generally ragged or uneven character of typical, unmanaged natural stands and (b) the obvious desirability of improving the growing stock while harvesting merchantable trees in these stands. In marking timber for partial cuttings, there is considerable difference of opinion as to whether certain trees should be cut or left. In order to settle such questions, it is necessary to find out what the trees will do if left. How fast will they grow and what mortality will occur? Since the growth and mortality of individual trees depends obviously on their size and character, and on their position with relation to other trees, the basic problem is to determine the specific relationships between the growth and mortality on one hand, and the size, character, and position of a tree on the other. With this knowledge, marking rules can be made more specific, and greater net yields and net profits will be obtained. Trees likely to die can then be cut, and trees that will increase markedly in value can be left.

Because of the opportunity to study growth and mortality under a wide variety of stand conditions on fresh cuttings, a tree-class study was started during the year on the methods-of-cutting plots established on the San Jacinto Experimental Forest in east Texas. A total of 269 loblolly pines, covering a wide range of tree characteristics and stand conditions, were tagged, measured, and described. An expansion of this study, involving loblolly and shortleaf pines less than 8 inches d.b.h., was also started. The growth and mortality of small trees is of particular interest because the possibilities for greatly enhanced value as a result of relatively little additional growth are excellent. At the same time, the natural mortality of some of these trees may exceed the increased growth and value of the trees that live.

Plans for 1939

1. A report on stand conditions following commercial cuttings of southern pine pulpwood will be completed.

2. All available tree-class data on growth and mortality will be analyzed in cooperation with the Mensuration project.

3. The Olustee experimental management plan will be put into full operation, and the possibilities of special, detailed studies of different phases of management will be investigated.

4. A review will be made of all available data on the silviculture of longleaf pine, with special emphasis on reproduction, and a comprehensive report will be prepared.

5. Additional field data will be obtained on the relation of slash pine growth to spacing.

Silvics

Silviculture, like agriculture, is concerned with the production of crops. Basic research on the physiology of crop plants has contributed markedly to progress in agriculture, and physiological studies of forest trees should contribute in a similar degree to progress in silviculture. Environmental or ecological studies are also important, since the response of trees to their environment affects both growth rate and quality. At present the two major lines of investigation in forest physiology and ecology are concerned with (1) the basic facts underlying the slow growth of longleaf pine seedlings under natural conditions, and (2) the nutrient and water requirements of pines in the nursery.

Studies of the response of longleaf pine seedlings to their environment have brought out very marked results. These show definitely that the stunted condition of many longleaf pine seedlings is due to a large extent to the competition between the pine seedlings and grasses for both moisture (during droughts) and mineral nutrients. Longleaf pine seedlings grown in cultures without grass made twice as much growth as those grown together with grasses. When the grass was burned and the ashes were returned to the soil, however, the pines grew nearly as much in the container with the burned grass as when grown without the grasses. Apparently the return of the minerals to the soil following the burning stimulated the growth of the pine seedlings. In the container in which the unburned grass was allowed to grow together with the pines, the grass apparently consumed the minerals which otherwise would have been absorbed by the pines alone. Under natural conditions where the fertility of the soil is low, the competition of grasses for nutrients undoubtedly is detrimental to the pines.

On an area from which all vegetation except longleaf pine seedlings was removed for 5 years, the pines have grown in height from an average of 0.1 foot in 1932 to over 9 feet in 1937, while in the area from which the grass was not removed, the pines in 1937 averaged only a third as high as those in the denuded plot. This field study, together with laboratory studies, definitely indicated that competition between grass and pines plays an important part in the natural regeneration of longleaf pine. Since grass competition reduces the growth of longleaf pine seedlings to about a third of what is possible without the grass, a cheap method for removing this competition might have practical value in the longleaf pine region.

Artificial reforestation is necessary on millions of acres in the South. Pine seedlings are therefore grown in nurseries, but the nutrient requirements of southern pines under nursery conditions are practically unknown. A study of longleaf, slash, loblolly, and shortleaf pine seedlings showed that definite symptoms are produced in the pines by different nutrient deficiencies. The greatest response was evident in the cultures lacking nitrogen. Under this condition, slash, loblolly, and shortleaf pines remained at a standstill after the development of the primary needles, while longleaf pine developed fascicled needles that were rather short and pale yellow with reddish brown tips. The least response was evident in the cultures lacking phosphorus. Of the species studied, loblolly pine was most sensitive in its response to nutrient deficiencies, while longleaf pine was least responsive. Whether the seed of the longleaf pine originally contained more mineral nutrients than that of the loblolly pine, enabling the longleaf pine seedlings to be supplied with mineral nutrients longer, or whether longleaf pine is not so exacting in its requirements, is a question than cannot be answered yet.

Environmental conditions affect the distribution of trees to a marked degree. Savannas, which originally supported stands of longleaf pine and which since clear-cutting have remained treeless, were studied briefly and found incapable of supporting pine reproduction because of the excessive moisture caused by poor drainage.

Plans for 1939

1. Study of the nutrient requirements of longleaf, shortleaf, slash, and loblolly pine seedlings will be continued.

2. A study will be made of the physiology of sprouting of scrub oaks and palmetto in order to find a method for controlling them in areas requiring such treatment.

3. In cooperation with Region 8, methods of reforesting savanna lands will be studied.

4. Studies of the relationships of longleaf pine seedlings to ground cover and to grass density will be completed.

MENSURATION

The mensuration work at the Station was formerly confined to the construction of volume tables, converting factors, taper tables, and yield tables for Region-wide application. This was in line with the general or exploratory nature of the early work of the Station. During the past few years, however, the expansion of National, State, and private forestry programs has shown the need for more accurate information on forest mensuration applicable to small areas. The Station is therefore concentrating on the development of suitable techniques for working out volume-table and growth problems on specific areas. It is impracticable to construct tables applicable to each particular forest, but with the right technique local tables can be made readily when needed.

In all fields of forest research, considerable emphasis recently has been placed on more accurate experimentation, and the mensuration project assists in designing experiments, in analyzing data, and in supplying better sampling procedures. During the past 2 years, for example, satisfactory procedures have been developed for sampling lots of pine seed and for making forest-nursery inventories. In the latter problem, the recommended procedures are similar to those used in cruising timber. One set of samples is taken to supply an estimate of the average density per sampling unit. This is comparable to the field tally in timber cruising. Another set of samples is taken to determine the relationship of percentage of plantable seedlings to density; this relationship is comparable to a volume table. The estimate of average density obtained from the first sample is referred to the relationship given by the second sample to obtain a corrected percent plantable, and the total number of plantable seedlings can then be computed readily. If the relationship between density and percent plantable is not constant, as assumed, a correction is necessary, and this phase of the problem is now being studied. The method devised by the Station is now being used in the Stuart Nursery, Pollock, La., and in the Ashe Nursery, Brooklyn, Miss.

One of the principal problems in forest management in the naval stores region is the effect of turpentining on the growth of trees. A study was started 2 years ago with the object of providing a method of estimating the growth of turpentined trees. From the analysis thus far completed, it is evident that the five most important factors to be considered are: (1) the past growth, (2) the number of years rested, (3) the diameter or circumference before the first or second face was installed, (4) the width of face installed, and (5) the species.

Most of the volume tables, taper tables, and data on converting factors in the Station's files were assembled during the year as the basis for a paper that will present the best tables and data for application in the South. In view of the great number of volume tables already constructed for various species, localities, products, merchantable limits, and scales, there is need for a compilation that will include the most valuable tables and provide references to the others. It is also planned to include information on simple checking and construction of volume tables and converting factors.

Plans for 1939

1. Examine the permanent yield plots recently established on many of the National Forests, to determine their use in connection with tree-class studies.

2. Complete the study of the growth of turpentined trees.

3. Complete the compilation and evaluation of tree-measurement data from the files, and assemble the most useful data for an Occasional Paper.

4. Establish a study of the correlation between the appearance of a dead tree and the period since its death. This information will be very useful in growth studies.

5. Adapt existing sampling procedures to the problem of plantation inventory.

6. Study and obtain a measure of the inherent variability of seed germination, nursery, and plantation data as a guide to designing experiments in these fields.

7. Assist the Silviculture project in developing more satisfactory methods of analyzing data, in studies of the growth and mortality of individual trees.

REGENERATION

Since the greatest part of forest planting in the South remains to be done, most of the research needed in this field, despite the contributions already made, still lies in the future. The planting program in the Southern Station territory expanded greatly in 1933, and now involves the use, by Federal, State, and private agencies, of upwards of 120 million trees annually, at a yearly cost in excess of half a million dollars. At this rate it would take almost 50 years to plant the more than 5 million acres of virtually denuded lands remaining, plus a vast acreage of understocked areas and abandoned fields. Planting for watershed protection, a most complex process, is in its infancy. And despite the advances in research and practice that made possible the successful expansion in 1933, each accomplishment in the program today reveals new problems involving immediate survival and cost, future growth rate and thrift, and ultimate quality and usefulness.

The object of the regeneration project is to supply the owners or managers of denuded and understocked land (along with their advisers) with the technical information needed to reforest it successfully by artificial means. This object will have been attained when effective planting methods and an essentially complete technical planting manual can be supplied for the various sites and species of economic importance in the South.

The present nursery and plantation studies are concentrated mostly on the Palustris Experimental Forest, in central Louisiana. (Planting for watershed protection is largely in northern Mississippi, under the Forest Influences project.) The seed studies are concentrated at the Harrison Experimental Forest in southern Mississippi. Since 1933, the main emphasis has been upon the seed, nursery, and plantation problems of Region 8 of the Forest Service, because of their representative nature, the direct help given the project by the Regional office, and the prompt and effective use made of the results. The vast increase in research field-work that followed the expansion of the planting program in 1933 has yielded much basic data, the analysis, reporting, and publishing of which is the most pressing task now confronting the project.

Information concerning the effects of geographic source of seed, seed storage and processing, and seed-testing technique, is urgently needed in the South. Cone-crop estimates and service germination tests are important research adjuncts. In nursery practice, improvement of specifications for plantable seedlings, control of nursery-soil fertility, and increase in percentages of plantable stock, are the outstanding needs. In planting, the greatest needs appear to be for information bearing upon initial survival; choice of species and site; conversion of scrub oak to pine; mixture of species; and spacing and arrangement as they influence costs of planting, quality of product, and effectiveness of watershed protection. A revolutionary method of direct seeding is needed, to take advantage of large seed crops and emergency labor, and to complete unsuccessful plantations and understocked natural stands. The fundamental problem of beneficial soil microorganisms is becoming more important every year in connection with both nursery practice and planting.

Work during 1938 essentially confirmed the index to maturity of southern pine cones devised in 1936 and 1937. This index is based upon a decrease in specific gravity of ripening cones that enables them to float in lubricating oil of grade SAE 20 by the time they become fully mature. On the Station's recommendation, this index was applied by the Forest Service in collecting its entire allotment of approximately 40,000 bushels of longleaf pine in the fall of 1938; it resulted in reduced seed spoilage and extraction costs and in almost complete elimination of seed loss through failure of cones to open. The net saving over seed costs before the maturity index was developed is thought to be several thousand dollars annually. Other seed studies confirmed the effectiveness of dry cold storage (moisture content of seed, 6-9 percent; storage temperature, 38° F.) for keeping longleaf pine seed over winter, and of cold storage for keeping seed of several pines for 1-2 years. In one test, longleaf seed was kept viable for 1 year at room temperature by reducing its moisture content to 6 percent and sealing it in the container. The project also prepared and distributed the eighth annual estimate of the cone crop of southern pines, and ran service germination tests for all the nurseries in Region 8.

In the nursery, the fertilizer and soil-crop rotation study reached the stage in which pine seedlings were sown following a soil crop; alternating pine annually with fertilized cowpeas was markedly superior to producing pine seedlings continuously as has heretofore been done in the South. Analysis of the 1937 soil-amendment study showed the following amendments to be effective on the relatively heavy Stuart Nursery soils (central Louisiana) in decreasing order of value: (1) compost; (2) rich virgin topsoil; (3) chopped rice straw; (4) fine quartz sand; (5) untreated check; (6) acid peat; (7) ground charcoal; (8) chopped pine needles; (9) bagasse (sugar cane pomace); (10) raw hardwood sawdust. Compost was outstandingly beneficial. The beds, which were resown in 1938, showed persistent residual effects of practically all treatments. Following the results obtained from this study in 1937, a new study was begun of the effects of various rates of compost application, combined with various seedling densities; it yielded much useful information concerning fertilizer practice, plantable percentages, and seedling grades.

In the plantations, the most striking results during 1938 were obtained in a phase of the initial-survival study that involved stored food reserves of longleaf and slash pine planting stock. The food reserves of seedlings of comparable grades (as defined for lifting and packing practice in the nursery) were altered by subjecting the stock to various degrees and periods of shading and defoliation from Nov. 1 to the date of planting (Jan. 25); survivals in the plantation ranged from 99 to 1 percent. This test, which reproduced experimentally a hitherto inexplicable pattern of serious mortality in plantations, strongly indicated that conditions in the seedbed in the late fall and early winter (which under Southern nursery conditions is a period of active photosynthesis) may be the controlling facto in the ability of the seedlings to survive in the field. Another promising lead, though less startling than that involving stored food reserves, was obtained from another phase of the initial-survival study—one dealing with stimulation of early root-growth. A series of treatments, including "auxilin," puddling in topsoil from nursery beds showing strong mycorhizal development, and puddling in loam mixed with chopped rootlets containing mycorhiza, all gave higher survival percentages and thriftier surviving trees.

Plans for 1939

1. Major emphasis will be placed on the preparation of office reports and publications; field work has been completed for 46 of the reports.

2. Longleaf seed-moisture equilibria, storage of longleaf seed in cones, and moisture relations of stored slash seed will be added to current storage tests.

3. The ninth annual cone-crop estimate will be made; service germination tests for Region 8 will be continued.

4. Seed studies will be extended to several species other than pine.

5. Fertilizer and soil-amendment studies will be continued.

6. New season-of-sowing studies and a new watering study will be made, to increase percentages of plantable nursery stock.

7. The plantation survival study will be continued, with emphasis on root stimulation and on internal food supply of the seedlings.

8. The study of conversion of oak brush to pine will be expanded.

9. A study of neglected phases of direct seeding will be started.

10. The more important physiological problems encountered in seed, nursery, and planting investigations will be formulated precisely for reference to the Silvics project.

Regeneration in Puerto Rico.—Puerto Rico has an all-year growing season, many highly productive forest sites, a wealth of native and introduced woody species, and a rural economy that make possible an extremely intensive use of land and forest products. Valuable furniture woods can be grown on short rotations, and twigs less than 1 inch in diameter find a ready sale for charcoal.

Some forest planting has gone on for many years in the Island, and after the emergency legislation of 1933 and later years, land acquisition by public agencies was accelerated and the planting program was expanded greatly. As there was no provision for formal forest research in the Island, and as planting investigations were urgently needed to guide the complex program undertaken, special CCC funds were set aside in fiscal years 1938 and 1939 to conduct the needed studies. L. R. Holdridge, a member of the Caribbean National Forest staff who had been in charge of planting, was placed in charge of the investigations; and Wakeley of the Southern Station staff visited Puerto Rico during April and May 1938 to help prepare a program of studies and to advise concerning experimental design.

An immediate attack on planting and nursery problems was undertaken with studies to determine the proper method of cutting back large nursery stock to obtain higher survival, to work out methods of seed storage to reduce the previous heavy losses in germination, and to devise a satisfactory tree-lifting tool for use with the ball-of-earth planting method on dry sites. The administrative staff assisted in studies of planting technique, seedbed cover, and depth of covering. Outside agencies have cooperated on "die-back" disease and on germination of Magnolia splendens. To date, 50 sketches have been completed for a popular tree booklet, and approximately 200 specimens have been collected for the herbarium. Furthermore, a weekly seminar on taxonomy is held for the staff and field men; and advice on planting problems with cooperative field trips, accumulation of reforestation data, and tree identification have comprised an important part of the work. A pamphlet describing the special-use permit system of combined agriculture and forestry on hill-country lands was prepared for publication.

Plans for 1939

It is planned to continue the present tropical-forest research program, the extent of which will depend on the availability of funds.

FIRE

The extent and general nature of forest fires in the South are indicated by two contrasting facts: approximately one-fifth of all forest land is burned over annually, and there are millions of acres supporting good stands of second-growth pine that have been repeatedly burned.

Despite the latter fact, however, uncontrolled fires cause tremendous damage throughout the South. Control of fire is essential to forest management, especially where periodic selective cutting leaves a more or less continuous extra hazard in the form of tops and logging slash; equally essential is a knowledge of what fire does to forest stands. The program of the fire project is directed toward the development of better methods of fire control, the measurement of fire effects, and the determination of how and when to use fire in forest management.

The last 2 years have seen the emphasis of the work under the fire project shift from the field of effects to the fields of behavior and control. An important contribution of the Station in the field of fire control is the development of a meter which accurately estimates the size and rate of spread of fires in grass fuels in the longleaf-slash pine type. This meter gives a basis for the use of a flexible suppression organization that can be expanded or contracted to agree with the changes in certain factors that affect the rate of spread (wind, fuel moisture, and fuel density). Immediate use will be confined largely to the National Forests of Region 8, which will try it out in the spring fire season of 1939. Fire-control organizations of State and private forests usually cannot be varied as rapidly as can those of the National Forests. Work has also been started on a fire-danger meter for the shortleaf-loblolly-hardwoods type.

It is in the field of fire effects that the most troublesome questions lie. To define fire-protection standards, which are based on costs of prevention and suppression and on loss in value from fires, is impossible without a reasonably accurate definition of these three factors and their interrelations; concerning the last of these, extremely little is known. There is urgent need for this information in the current work of fire-protection replanning and in the revision of methods of damage appraisal. Another phase of fire effects that is being studied is the use of fire in forest management; much of this field is still largely a matter of opinion and conjecture and consequently is fraught with conflicting evidence and claims.

Plans for 1939

1. Behavior and control studies will be extended to the shortleaf-loblolly-hardwoods type.

2. A fire-danger meter will be tested on National Forests in the longleaf-slash pine type.

3. A fire-danger meter will be developed for the shortleaf-loblolly-hardwoods type.

4. Studies of the use of fire in forest management will be continued.

5. The gross effects of fire will be studied and a rough basis for damage appraisals developed.

6. Supplementary data on the longleaf-slash danger meter will be taken in order to increase the precision of the estimate of discovery time.

7. A study of the physiological response of pine to fire will be started in cooperation with the Silvics project.

NAVAL STORES

Thirty years ago the United States produced 80 percent of the world's supply of turpentine and rosin; today it produces only 62 percent. Thirty years ago gum naval stores accounted for all of the United States' production, but today, owing to the development of wood naval stores and sulphate turpentine, gum naval stores account for only 74 percent of domestic production. The result of these trends is that the current annual world consumption of gum naval stores produced in this country is approximately 500,000 barrels of turpentine and 1,700,000 barrels of rosin. This amount probably will not be exceeded in the future unless some unforeseen, increased uses are found. According to Forest Survey findings, there will be adequate timber available to supply such a production indefinitely, even after making allowance for considerable expansion of wood-products industries. Competition from mineral spirits, which have permanently replaced much turpentine for thinners and solvents, together with large carry-over stocks resulting from depressed domestic demand during recent years, has resulted in a continuous shrinkage in market values. Production costs have been reduced in recent years, but there is great need for still further reduction by putting into effect more efficient woods practices.

A large part of the Station's present program is devoted to this objective. The possibilities of stimulating gum yield by applying chemical reagents to the freshly streaked face, for example, were investigated during the full 1938 chipping season; 5- and 20-percent solutions of sulphuric acid, acetic acid, and commercial washing soda were applied in treatment combinations with streaks 1/4, 5/8, and 1 inch high on both longleaf and slash pines. Analysis of the field data has not progressed far enough to report any detailed results, but it is apparent that the application of sulphuric acid stimulates gum flow considerably.

In cooperation with the Georgia Division of Forestry, a study was made of the gum yields from small plantation-grown slash pines near Macon, Ga., 20 miles north of the natural range of the species. For first-year work, trees 5 inches d.b.h. yielded 10 to 18 units per crop, depending upon growth rate; 7-inch trees, 23 to 31 units; and 9-inch trees, 37 to 45 units.

In the study of advance streaking on slash pine, it was found that faces which received advance streaks 21 weeks and 9 weeks ahead of regular chipping produced during the first 10 weeks of the season 16 and 12 percent more gum, respectively, than faces not advance-streaked. The stimulating effect of the advance streak was apparently lost after the first 10 regular streakings, however, and the yield advantage of the advance-streak treatments amounted to 5 and 4 percent, respectively, in terms of the total yield for a 32-streak season.

Several of the various factors that influence gum yield and production costs were studied during the year. The Station has in the past given out much information from separate studies of this kind to promote improved practices and greater net returns. There is an increasing demand, however, for more detailed, coordinated, and comprehensive information, especially in connection with the growing practice of gum farming, i.e., naval stores extraction as a part-time venture on the farm woodlot or small forest property. Before much new work is begun, therefore, there is urgent need to report on all studies which have already been concluded in the field, and to assemble and summarize them in a comprehensive publication on woods practices. Most of the work done during the year was directed towards this objective.

Plans for 1939

1. Complete a report on the frequency-of-chipping study.

2. Complete a report on the advance-streak studies.

3. Complete a report on the chipping-specifications study on vigorous young slash pine.

4. Initiate a study to determine gum yields from faces of various widths on trees of various diameters.

FOREST SURVEY

The Forest Survey, which was authorized by the McSweeney-McNary Act of 1928, was actively initiated in the Deep South in 1932 after a short experimental period. It took slightly over 4 years to complete the field work, but as early as 1934 the Survey started issuing releases of resource data. One comprehensive Survey unit report and 30 resource releases were sent out prior to 1938; while 2 complete Survey unit reports were published and 11 comprehensive unit reports were issued during 1938. In addition, several articles were published dealing with the forest resources of the Deep South.

A large part of the time of the Survey organization in 1938 was given to filling requests for Forest Survey data. The Survey supplied the Regional Forester with resource data for three State reports, cooperated with the National Resources Committee and the State Planning Boards on a Southern Forest Resource report, prepared resource information for the Joint Congressional Committee report, and filled numerous requests from forest industries and other organizations interested in the Southern forest situation.

For the first time, compilations of data based on the field survey have been completed for the entire Deep South. This field survey covered the commercial timber belt of east Texas and southeast Oklahoma; approximately three-fourths of Arkansas; the south Missouri Delta, which is included with Arkansas in the following tables; Georgia (except the Okefenokee Swamp and Coastal Islands); Florida (except the Ocala National Forest and the Everglades); and all of Louisiana, Mississippi, and Alabama.

The area surveyed totaled nearly 210 million acres, of which nearly 59 percent was classified as productive forest land (table 1). In each State more than 50 percent of the area surveyed was in productive forest land. Old-growth stands were found on nearly 15 percent of the productive forest area; second growth, including reproduction, on about 77 percent; and clear-cut forest land on only 8 percent.

Table 1.- Productive forest area of the Deep South by States and forest conditions 1/

State	Total area surveyed	Proportion in productive forest area	Productive forest area	Forest condition				
				Old growth	Second growth		Reproduction	Clear-cut
					Sawlog size	Under sawlog size		
	Thousand acres	Percent	- - - - - - - -		Thousand acres	- - - - - - - -		
Texas	18,516	57.0	10,553	1,461	5,601	2,926	343	222
Oklahoma	4,026	73.5	2,961	447	966	1,462	84	2
Arkansas	26,332	56.3	14,820	2,441	7,343	4,583	348	105
Louisiana	29,078	55.7	16,194	3,342	6,712	3,974	608	1,558
Mississippi	29,655	53.5	15,869	1,884	6,441	5,746	929	869
Alabama	32,693	57.7	18,860	2,497	7,676	7,337	864	486
Georgia	36,788	57.2	21,036	2,555	8,812	7,733	1,112	824
Florida	30,984	69.9	21,653	3,317	3,793	7,621	1,538	5,384
Total	208,072	58.6	121,946	17,944	47,344	41,382	5,826	9,450
Percent of productive forest area			100.0	14.7	38.8	33.9	4.8	7.8

1/ Data as of year of survey (chiefly in 1934, 1935, or 1936).

Altogether the Survey found nearly 1½ billion cords of sound material in the forests of the Deep South (table 2). This material was in all trees 5 inches d.b.h. and larger, including upper stems to a 4-inch minimum and the limbs of sawlog-size hardwoods and cypress. It also includes the sound material in cull trees. It is interesting to note that 63 percent of this volume was in hardwoods and cypress, and 37 percent in pine; these proportions are nearly reversed when only the sawlog-size trees are considered, as shown in table 5 in board feet.

Table 2.—Cordwood volume, including bark, of sound material

State	Total volume	Pine volume	Hardwood and cypress volume
	- - - - - - - -	Thousand cords 1/	- - - - - - - - -
Texas	152,744	67,940	84,804
Oklahoma	24,378	8,113	16,265
Arkansas	221,334	66,032	155,302
Louisiana	236,686	53,729	182,957
Mississippi	201,007	58,764	142,243
Alabama	224,424	95,702	128,722
Georgia	249,988	125,436	124,552
Florida	138,783	60,731	78,052
Total	1,449,344	536,447	912,897
Percent of total	100.0	37.0	63.0

1/ Data as of year of survey (chiefly in 1934, 1935, or 1936).

Considerable progress was made during 1938 in bringing up to a common date the Survey data obtained by the field survey in different areas over a period of 4 years. This was made possible through growth and industrial drain studies—the first, to determine the volume added naturally in the forests of the Deep South, and the second, to estimate the drain upon those forests by industries. The data upon which growth estimates are based were obtained at the time of the field survey. It has been necessary to make supplementary industrial-drain studies from year to year in order to obtain data on the annual drain. In 1936, the Survey found more than 10,000 active primary forest-industrial plants (table 3). Over 8,000 of these plants are sawmills, more than 7,500 of which have a daily capacity of less than 20,000 board feet.

Table 3.—Primary forest industrial plants, 1936 1/

State	Total number of plants	Sawmills	Other primary plants	Turpentine stills
Texas	639	535	103	1
Oklahoma	85	75	10	-
Arkansas	1,011	837	174	-
Louisiana	646	556	86	4
Mississippi	1,813	1,690	102	21
Alabama	2,473	2,181	166	126
Georgia	2,338	1,591	104	643
Florida	1,080	602	170	308
Total	10,085	8,067	915	1,103

1/ Naval stores stills are those active during the 1934-35 season.

In table 4, the annual forest increment, which is the net natural change in volume in the forests for any one year, is compared with the drain for industrial and domestic use by States for 1936. Only Texas, Arkansas, and Georgia showed a surplus of pine increment over industrial drain in board feet (lumber tally); both Mississippi and Florida had large deficits. Texas, Alabama, and Georgia showed surpluses of increment over drain for hardwoods and cypress; Arkansas and Florida had the largest deficits. For the Deep South as a whole, the deficit in all species totaled more than 1 billion board feet during 1936.

Table 4.—Comparison of net increment and drain in board feet (lumber tally), 1936

State	Pine		Hardwoods and cypress		Net change in growing stock	
	Increment	Drain	Increment	Drain	Pine	Hardwoods and cypress
	Thousand board feet					
Texas	1,439,500	1,214,500	408,400	366,500	+225,000	+41,900
Oklahoma	94,300	167,700	10,900	41,200	-73,400	-30,300
Arkansas	1,095,800	914,000	861,600	1,144,400	+181,800	-282,800
Louisiana	1,005,300	1,183,600	896,500	1,024,000	-178,300	-127,500
Mississippi	1,154,200	1,615,600	940,000	1,112,500	-461,400	-172,500
Alabama	1,455,500	1,762,900	600,600	476,100	-307,400	+124,500
Georgia	1,896,600	1,208,300	543,900	426,600	+688,300	+117,300
Florida	443,800	894,500	219,000	559,800	-450,700	-340,800
Total	8,585,000	8,961,100	4,480,900	5,151,100	-376,100	-670,200

Through the use of estimates of the net change in growing stock sinc the year of the survey in each area, it has been possible to bring the inventory figures up to Jan. 1, 1937 (table 5). These data indicate that nearly 56 percent of the board-foot volume in the Deep South is in pine species and that only 44 percent is in hardwoods and cypress. Georgia has the largest pine volume with more than 33 billion board feet, followed by Alabama with more than 25 billion. Louisiana has the largest volume of hardwoods and cypress, totaling more than 26 billion board feet, followed by Mississippi with more than 19 billion.

Table 5.—Board-foot volume (lumber tally), Jan. 1, 1937

State	Total volume	Pine	Hardwood and cypress
	- - - - - - - - Thousand board feet		- - - - - -
Texas	28,923,600	18,753,600	10,170,000
Oklahoma	3,517,100	2,440,900	1,076,200
Arkansas	36,315,500	17,839,300	18,476,200
Louisiana	41,759,900	15,176,800	26,583,100
Mississippi	35,325,100	15,577,900	19,747,200
Alabama	38,564,100	25,125,400	13,438,700
Georgia	46,595,400	33,051,200	13,544,200
Florida	21,999,500	13,273,200	8,726,300
Total	253,000,200	141,238,300	111,761,900
Percent of total	100.0	55.8	44.2

The Survey also completed analyses during 1938 of the relative stocking of the principal forest stands in each Survey unit in the Deep South. These showed conclusively that the stands are only one-half to one-fourth stocked. This can undoubtedly be laid to frequent forest fires and to indifferent treatment over a long period of years. With adequate fire protection and good forest management, the growing stock in many localities could be doubled in two or three decades; in some, it could even be tripled

This understocking is a challenge to a South in need of growing industries to help solve its social and economic problems. The recent expansion of the pulp and paper industries in this area has greatly stimulated interest of forest landowners in the application of good forest management. The industrial opportunities that would be opened up with the doubling of the forest resource would go far toward solving the unemployment problems resulting from the shrinkage in cotton production. To attain social and economic security in the Deep South, however, damage from forest fires must be reduced, good forest management must be applied, and outlets for forest products must be developed.

Plans for 1939

1. Continue the preparation and publication of Survey reports for units covered by the inventory. This includes (a) the publication of releases for 13 Survey units, and (b) the preparation of 5 or more State reports and of a complete report on the forest resources of the lower South.

2. Carry on the field and office work necessary to calculate the drain on the forests of the South for industrial and domestic use during the calendar year 1938. This will be accomplished largely through cooperation with the Bureau of the Census and the Interstate Commerce Commission.

3. Determine for 1938, in cooperation with the Naval Stores Conservation Program, the supply of round timber available for gum naval stores operations.

4. Complete an extensive survey of the timber resources of the post oak regions of Texas and Oklahoma, and make a line-plot survey of the timber resources of northwest Arkansas.

FOREST ECONOMICS

NEW PUBLIC DOMAIN

One of the major reasons for tax delinquency of forest land in certain parts of the South is the high tax levied for financing drainage enterprises to reclaim land for crop production but on which the costs are prorated over all land within each enterprise. This problem, as it exists in the Delta of Mississippi, was investigated in 1937, and a report, "Taxation of forest land in the Yazoo Delta of Mississippi," was issued (Occasional Paper #74) in 1938. For alleviating the problem in this area, this report made specific recommendations, which are applicable in large measure to similar situations in other sections of the Mississippi Delta.

Another problem of particular interest to certain States in their efforts to conserve and develop their forest resources involves (1) the failure of their present statutes to conform to the requirements for Federal aid set forth in Section 2(a)of the Fulmer Act (Public #395, 74th Congress), and (2) the extent of tax-forfeited land in such States, from which the nucleus of State Forests envisaged in the Act might be formed. To attack this problem in both phases, studies were undertaken in Oklahoma to determine: (1) changes in the present statutes necessary to bring them into conformity with the Fulmer Act; (2) location, area, assessed value, and delinquency history of lands now in county title for nonpayment of taxes, and of lands eligible for forfeiture to county title; and (3) other changes in law and practice deemed requisite or advisable to make the levy and collection of rural real-estate taxes more equitable.

Field work and analyses of data were completed for 6 Oklahoma counties, each being representative of a major physiographic region of the State—Adair, Beaver, Creek, Jackson, Latimer, and Love. Partial data were also obtained in Carter and Tillman Counties. A first draft of a report on this study has been completed.

Outstanding results of this survey may be summarized as follows:

1. The greatest extent of long-term delinquency is found in the Eastern Cross Timbers and the upland hardwoods of east Oklahoma; next greatest extent in the Southern Cross Timbers, the pine-hardwoods of southeast Oklahoma, and the Panhandle; and least delinquency in the Rolling Prairies of the southwest part of the State.

2. The area involved in long-term delinquency ranged from 27 to 30 percent of the gross county area in northeast Oklahoma and from less than 0.5 to 4 percent in southwest Oklahoma; it averaged 13 percent for the eight counties studied.

3. In forested counties (Latimer, Adair, Creek, and Love), more forest land than crop or pasture land is eligible for forfeiture or has been forfeited.

4. Very wide latitude in tax-collection enforcement procedure is allowed the individual counties, resulting in wide disparity among them in respect to enforcement.

5. In spite of a "mandatory" provision in the Statute code that "tax sales" and "resales" "shall" be held "annually", no county carries out this statute.

6. No significant relationship was found between the extent of long-term delinquency and the strictness of tax-collection enforcement.

Recommendations have been drawn up for amending the statute code to permit Oklahoma to qualify under Section 2(a) of the Fulmer Act, to enforce State-wide uniformity in tax-collection procedure, and to effect other improvements. The results of this study and recommendations will be issued as an Occasional Paper early in 1939.

Plans for 1939

1. Complete the report on "The extent of long-term tax delinquency in certain Oklahoma counties."

2. Analyze the problem of tax delinquency of forest land in the South, based on research over the past 7 years, preliminary to the preparation of a statement setting forth (a) the major problems, present delinquency conditions, trends, and causes, and (b) the contribution of Station studies to the solution of these problems.

3. Study the distribution and total amount of property taxes levied on various areas and conditions of forest land in each of the major forest regions of the South. The details of methodology for this study will be worked out after one representative county has been studied.

PRIVATE FORESTRY

About 93 percent of the commercial forest land in the South is in private ownership—40 percent in farm woodlands and 53 percent in industrial and other private ownership. Maintenance and stabilization of land ownership and of the forest industries, with their associated communities, depend very largely on keeping forest lands continuously productive. Satisfactory private-forest management must not only produce continuous yields of merchantable forest products but also produce them with a reasonable margin of returns over costs. Investigations in private forestry are determining the possibilities of profitable rehabilitation, management, and utilization of second-growth forests by correlating in a practical way the economic requirements of forest owners with those measures necessary to maintain and build up the forest resources.

In order to demonstrate practical private forestry and to accumulate records of costs and returns from improved forest practices, the Station's private-forestry investigations since 1934 have been made on the Crossett Experimental Forest, an area of 1,680 acres of typical second-growth shortleaf and loblolly pine in southeast Arkansas, donated by the Crossett Lumber Co. Investigations have included studies of (1) costs of truck and tractor logging; (2) values of trees by size-classes when utilized for sawlogs, pulpwood, posts, and chemical wood; (3) costs and returns of thinning and improvement cutting; (4) costs of marking and of making inventories, and the effects of different lengths of cutting cycles upon costs and returns of selective timber management.

During 1938, a ledger showing (1) growing stock, (2) yields in volume and value from cuts of sawlogs, pulpwood, posts, and chemical wood, (3) costs of management, (4) costs of utilization, and (5) man-days of labor employed, was set up for each 40 acres on the Crossett Experimental Forest as a management unit. Improvement cuttings and thinnings, which profitably removed 1,760 cords of pulpwood and chemical wood, were made on 15 forties. Harvest cuttings were made on 10 forties, using cutting cycles of 3, 6, and 9 years. A total of about 870,000 board feet of pine and hardwood logs was removed, and records of costs and returns from operations on each management unit were obtained. Also a study was made of truck logging with detachable trailers, which could be loaded while the truck was delivering a load of logs to the landing.

The private forestry investigations are showing definitely that selective timber management of second-growth shortleaf and loblolly pine is profitable. Net annual incomes per acre range between a few cents and several dollars, depending largely upon the quantity and quality of growing stock, the site, and skill of management. Average second-growth stands of 3,000 board feet of saw timber per acre (13 inches d.b.h. and over) show an annual net income, above all costs of protection and management, of over $1 per acre. Studies have not progressed far enough to recommend definitely the length of period between cuts, the optimum amount of growing stock, or other details; but frequent light cuts, which remove less volume than the residual stand will restore by growth during the ensuing period and which will result in building up understocked stands, are known to be desirable and have been found economically feasible. The cut, when limited (as far as the felling budget will permit) to trees financially mature because of size, poor condition, or low capacity for growth, improves the quality of the residual stand and, furthermore, by shifting growth from trees of poor form and vigor to better trees, assures an increased volume and an improved quality of future yields. The net income of the present cut generally is increased by adopting selective cutting because the larger average logs yield high-quality lumber and are handled in the woods and mill at a lower cost per unit. Improvement cuttings for pulpwood, which removed defective, crooked, and limby pines unsuitable for saw timber, have netted about 80¢ per unit (144 cu.ft.). Trees containing at least two sticks of pulpwood have been cut at a profit, but small trees barely have paid their way; 9- to 11-inch trees have yielded the greatest net returns for pulpwood. Pulpwood cut in thinning dense young stands netted $1.20 per unit. Improvement cuttings of limby and defective individuals and also of those species of hardwoods that are not merchantable for saw timber resulted in a net income of about 25¢ per unit of chemical wood (138 cu.ft.), but large limby oak trees, most hickory trees, and all hardwoods below 7 inches d.b.h. failed to pay their way. For selective cutting in the flat country, truck logging, which loads the logs at the stump without constructing woods roads, has been found efficient and economical. A recent study of truck logging using a detachable trailer indicates that, by freeing the truck while loading is being done, the total per-unit cost of truck logging can be reduced 20 to 30 percent.

The results of the Private Forestry studies are being made available currently as Occasional Papers, in trade journals and other publications, or in talks before lumbermen and other interested groups. During 1938, about 530 lumbermen, pulpwood producers, foresters, and others inspected the results of the private-forestry investigations on the Crossett Experimental Forest. A recent Forest Service survey of the status of private forestry in the South indicated that selective timber management, as demonstrated on this forest, has been adopted by companies owning several million acres of forest land in the shortleaf and loblolly pine region.

Plans for 1939

Shortleaf-loblolly pine region (Crossett Experimental Forest).-

1. Study effect of 1-, 3-, 6-, and 9-year cutting cycles upon costs and returns, 7 additional 40-acre management units to be cut selectively.

2. Determine costs and returns of thinning additional old-field pine stands and of improvement cuttings in these stands that will not be cut for saw timber for some years.

3. Continue studies (a) to improve methods and to lower costs of logging, and (b) to determine the number and quality of roads needed for efficient and economical transportation of forest products.

4. Determine through cost-production studies and financial analyses what constitutes a marginal log under different market conditions.

5. Study the economic advantages of using tree and log grades in timber inventories and sales.

6. Compile available data bearing on the financial aspects of private forestry, and set up estimates of the financial results to be expected from the application of forestry to typical properties in the shortleaf and loblolly pine region.

Slash-longleaf pine region. - Through contact with private owners, foresters, and others, define the most acute problems of private forestry in the slash-longleaf pine region, with the ultimate aim of extending private-forestry investigations into this region.

FOREST INFLUENCES

Despite limited personnel, good progress was made on Forest Influences research work at the Irons Fork Experimental Forest in the Ouachita Mountains of Arkansas and the Chewalla Experimental Forest in the Loessal Uplands of northern Mississippi.

The Department's watershed surveys are greatly emphasizing the long-standing need for technical information on upstream-engineering measures for regulating streamflow, particularly in planning watershed-improvement programs for headwater streams that drain undeveloped lands such as comprise a large part of the Ouachita Mountain region; in spite of the fact that "upstream engineering" has become a popular catch phrase, little research is under way in this important field. A short-term preliminary study undertaken during the past year on the Irons Fork Experimental Forest is designed to partly fill such a need by testing several types of retarding works that can be built entirely of native materials and that may prove effective in reducing or delaying flash run-off. The structures being tested are: (1) water-storage trenches of varying design to trap and temporarily store shallow ground-water drainage as well as surface flows, before these contributors to storm run-off can reach streams; (2) diversion-spreading works, the purpose of which is to divert storm run-off from steeply pitched channels and to dispose of it by means of spreading-infiltration devices located at points well above the water table; and (3) various types of earth- or rock-fill impounding dams to provide temporary storage for stormflow after it is delivered to stream channels. As a preliminary phase of the study, a number of trial structures was constructed in a 111-acre watershed, and systematic observations were begun to gage the retarding effects of these works and their probable contribution to the reduction of flood flows immediately downstream.

Data obtained during the year in connection with preliminary water-cycle studies appear to shed further light on the causes for flashy behavior of the Ouachita streams. Records from 64 run-off plots for 17 months (June 1937-November 1938) indicate that comparatively little rainfall reaches stream channels via surface run-off in the four watersheds under investigation. Of the total rainfall (about 73 inches for the period) an average of only 3 percent ran off the surface, and from no plot, regardless of cover type, did the total overland flow exceed 9 percent of the rainfall for the period. Observations of water-table fluctuations in valley-fill material adjacent to stream-gaging stations, as well as those made in connection with exploratory excavations in rock-talus areas, indicate that there is rapid movement of ground water through the rocky substrata; this possibly accounts in large part for the exceedingly sharp rises in streamflow. The talus areas appear to be heavy contributors to flash run-off, since they seem to offer little obstruction to run-off and permit rainfall to sink through the rock mass and reach channels quickly via subterranean routes. They are often very extensive. A survey of one talus slope revealed that an area aggregating 5 acres was covered with huge boulders to a maximum depth of 24 feet, all of the rock being overcast material, as evidenced by an underlying weathered soil profile. The prevalence and extent of these talus areas give rise to special problems in water control, for which several possible remedies are under consideration.

In the South, a greatly expanded road-building program on National Forests has in recent years created demands for cheaper and more effective methods of stabilizing raw eroding cutbanks and fills. There are outstanding problems of this sort on the Holly Springs National Forest in northern Mississippi, where the Station has had a comprehensive roadbank-fixation study under way since 1936. This study is designed to develop techniques that will reduce maintenance costs and safeguard other watershed values without resort to costly block-sodding methods or excessive bank sloping such as are employed on most public-road construction projects. During the year, 244 additional plots were established on 2,400 linear feet of bank with 1:1 or $1\frac{1}{2}$:1 gradients to confirm earlier results and probe several special problems.

Results of major import from the 1938 trials are:

1. For the first time since the study was initiated, highly effective plant cover was obtained from seeding. Bermuda grass, crabgrass, and Korean lespedeza seed, when sown on specially prepared banks, gave excellent results.

2. Small sods produced a better cover of Bermuda grass than was obtained by planting the stolons; spacing 12 inches apart produced better cover than wider spacing of the plant material.

3. Better plant cover was obtained from a top dressing of soil 3 inches deep than from more shallow coverings; heavy applications of a 6-8-6 fertilizer to raw cutbank soils did not compensate for the omission of topsoil dressing and produced unsatisfactory control.

4. For the second consecutive year, cutbanks planted or sown in the spring produced a plant cover far superior to that obtained on fall-planted banks.

5. Of the types of overwinter protection used in the trials, brush-litter protection or no cover at all produced the best stand of plants, cotton fabric the second best, and a temporary winter cover crop the poorest of all; all types of cover had a tendency to inhibit plant growth.

6. Sodding or sowing natural fill-slopes without using fertilizer or topsoil dressings produced excellent plant cover and effective control; use of a brush-litter mulch without subsequent planting likewise produced a fairly satisfactory stand of volunteer plants on fill-slopes but not on cutbanks.

7. The method of planting scarified, top-dressed backslopes provided much better control than contour-trench planting.

One of the better treatments developed in the Holly Springs study was applied in June 1938 to one of a pair of roadbanks from which soil losses have been measured for over a year. Bermuda-grass sods were planted 1 foot apart on a $1\frac{1}{2}$:1 slope, over which a thin layer of fertilized topsoil had been applied. Fertilization with a complete 6 8-6 mixture was light, at the rate of 1 pound per 100 square feet. The treatment produced a complete sod in about 40 days. About 3 weeks after the bank was planted, it absorbed every drop of a 1-inch rain, whereas run-off from the untreated bank exceeded 60 cubic feet.

In the Southern Region, there continues to be a need for cheaper methods of controlling erosion and water run-off on impoverished, abandoned farm lands. The area requiring such treatment is so vast that unless costs of restoring watershed cover are reduced to the very minimum, remedial programs on a sufficient scale to really cope with watershed problems may not be practicable. Since their inception, the Holly Springs studies have been concerned with this problem, and the development of effective cover-restorative measures that require a minimum of supplemental works has received the main emphasis.

During the year, trials were made of several devices that may be useful as substitutes for temporary check dams in improving growing sites for vegetation. One of these consists of a series of simple trenches or catch-pits dug in the hard residual soil of a gully bottom at right angles to the flow-line to catch and retain the soil brought down by run-off. When full, the trenches provide areas of moist, well-aerated outwash soil which make excellent planting sites for trees or other vegetation. Small-scale trials made in 1935-36 indicate that soil-collecting trenches are feasible and can be used to provide planting sites in certain types of gullies in which check dams cannot be employed effectively or economically.

Another contribution to gully-control technique was the issuance during the year (as Occasional Paper #76) of instructions on how to construct the pole-frame brush dam—a cheap, dependable type of structure developed in the Holly Springs studies.

Plans for 1939

Main efforts in Influences work will be concentrated on the Irons Fork Experimental Forest, where emphasis will be placed on continued trials of watershed-improvement measures for the Ouachita region; this type of research requires chiefly hand labor and little cash outlay, is short-term in character, and gives more promise of supplying information for which there is urgent need than any other type of experimentation now under way at Irons Fork. If emergency funds continue in sufficient amounts, temporary stream-gaging stations will be replaced with permanent installations; labor will be utilized on channel-improvement work at stream-gaging sites; water-cycle investigations will be continued, applying various cover-alteration treatments during October and November to half the run-off plots in the Hoover and Nesbitt Creek Units; and an inventory will be made of forest-litter types, as the first phase of a study of ground cover in relation to rainfall interception and retention.

At Holly Springs the roadbank-fixation study and the trials of gully-control devices will receive first attention. The roadbank study will be completed during 1939, and instructions and technical guidance will be furnished in applying recommended treatments on National-Forest roads. The other erosion-control studies will be continued, although only infrequent periodic observations may be required for several years. Most of the water-cycle investigations here will be completed, although observations in connection with several of the recently undertaken studies will be continued unless drastic retrenchment is necessary. These latter investigations include (1) a short-term study to ascertain the extent to which forest establishment reduces storm run-off from old-field drainage units, and (2) observations of surface run-off in relation to rainfall penetration and retention by soils under various types of cover. Data from studies of this type are needed urgently for the Upper Coastal Plain (including the Loessal Region of Mississippi) and will contribute to the solution of pressing problems encountered in watershed surveys and other important phases of land-use planning.

FLOOD-CONTROL SURVEYS

Since 1937 the Station has assisted in preliminary examinations and surveys of watersheds—an activity which was authorized and assigned to the Department of Agriculture by the 1936 Flood Control Act. Preliminary examinations are first made to determine whether there is a sufficient flood problem and likelihood of its solution to warrant a more detailed watershed survey, the purpose of which is to formulate a specific program for alleviating flood damage through the application of upstream measures and improved land practices designed to retard run-off and to control soil erosion. A survey, therefore, requires an inventory of all land-use practices that relate to water use and control; an appraisal of the extent to which each measure can reduce or prevent flood damage; and the formulation of a basin-wide remedial program, the costs of which must not exceed anticipated benefits. The Department's flood-control investigations are administered by field committees, each made up of a representative of the Bureau of Agricultural Economics, Soil Conservation Service, and Forest Service. Responsibility for certain preliminary examinations and watershed surveys has been assigned to the Station, with technical assistance provided by representatives of the other two bureaus.

During 1938, efforts were concentrated on initiating the first intensive watershed surveys to be undertaken in this Region. A detailed survey in Mississippi of the Little Tallahatchie River—a tributary of the Yazoo—was authorized in July 1938. Other surveys in which the Station is participating were also authorized for the Trinity and Concho Rivers in Texas. These three drainage basins have outstanding flood problems, as disclosed in preliminary examinations made in 1937-38.

In August, field work was started on the Little Tallahatchie survey, with headquarters at Oxford, Miss., and the project was about 20 percent completed by the end of the year. The other Bureaus were assisted in bringing the Trinity survey to 22 percent completion and the North Concho (tributary of the Colorado River) survey to about 50 percent completion. During the year, the Station assigned ten technically trained men to this work, the positions being filled mainly through transfers from the Administrative organization.

Good progress was made in other flood-surveys activities. Preliminary examination reports were completed for the Pearl, Coosa, and Yazoo River watersheds, and a report for the Ouachita River was approximately 30 percent completed. Also, the other Bureaus were assisted in completing preliminary reports for the Sabine, Neches, Colorado, and Lower Arkansas Rivers and in holding public hearings for the Red, Arkansas, Sabine, and Colorado basins. Another accomplishment was the development of a comprehensive card file of maps and other reference material pertaining to flood control and related subjects.

Plans for 1939

The principal goals are (1) to complete the Little Tallahatchie survey by Dec. 31, 1939, and to assist the other Bureaus in completing the Trinity and Concho watershed surveys; (2) to prepare preliminary examination reports for the Ouachita, Homochitto, Big Black, and Tombigbee Rivers; and, (3) to assist in preliminary examinations of the Apalachicola, Savannah, Lower Red, and Brazos Rivers. Additional detailed surveys may be authorized for other drainages in Southern Station territory.

Cooperating Agencies

BUREAU OF PLANT INDUSTRY

FOREST PATHOLOGY

In 1938 the study of the native canker-forming rusts, *Cronartium fusiforme* and *C. cerebrum*, became the main subject of investigation. Emphasis was given first to collection of factual data to determine the prevalence, distribution, and severity of rust infection on southern pines. The survey of reproduction included plantations and natural stands in Texas, Arkansas, Louisiana, Mississippi, Alabama, Florida, and Georgia. Pines infested with *Cronartium* cankers were found in all areas visited; the percentage of infection ranged from less than 1 percent to more than 50. In general, the plantations and natural stands most heavily infected were found in southeast Louisiana, south Mississippi, and south Alabama, but several plantations with more than 30 percent infection were found in Florida and Georgia. Infection was relatively light (seldom over 5 percent) west of the Mississippi River and in the northern parts of the Gulf States.

A study of the relative susceptibility, or telia-bearing capacity of the oaks common to the southern pine region indicated that *Quercus nigra*, *Q. marilandica*, *Q. cinerea*, *Q. phellos*, and *Q. rubra* are the more heavily infected oaks; *Q. catesbaei*, *Q. laurifolia*, and *Q. prinus* were frequently infected but had fewer telia than the former species, while

Q. stellata and Q. stellata var. margaretta apparently are resistant to infection and develop few telia.

The removal of branch cankers to prevent extension of cankers into the trunk was recommended as a means of reducing losses in young plantations with many branch infections. Pruning instructions were prepared, and members of the office have cooperated with CCC crews in the field, helping to familiarize the men with cankers and their proper removal from trees that did not have stem infections.

A survey of 15 southern nurseries growing slash and loblolly pines showed that rust infection ranged from none in some nurseries to as high as 30 percent in others. The heaviest rust infection occurred on the early-planted pine and least on the late-planted stock. Where nursery infections occurred, it was advised to discard diseased seedlings at lifting time.

Observations on survival of nursery-infected seedlings after planting in the field indicate a much higher mortality among such plants during the first growing season than among vigorous, disease-free seedlings in the same plantation. It is estimated that few of the diseased plants will survive a second season in the field.

More than 100 nursery seedlings with galls ranging in size from slight swellings to obvious cankers were examined under the microscope; the rust fungus was always present. Other examinations indicate that the pathogen does not extend more than 1 to 2 inches beyond the swollen areas.

As an investigational problem in forest pathology, the brown-spot project was essentially complete at the end of 1938. The work during the year consisted of: (1) taxonomic studies, (2) inoculation work, (3) tests to determine the effect of environmental factors on the fungus growing under laboratory conditions, and (4) making height measurements and quantitative estimates of foliage infection on seedlings in several areas where fungicidal control of the disease had been demonstrated for several years.

Plans for 1939

It is planned in 1939:

1. To re-examine permanent plots established in 1937 in order to determine the effect of the rust infection on mortality and growth rate; to extend the survey of plantations and stands of natural reproduction to areas not already covered; to establish demonstration plots in nurseries to show (a) the effects of spraying and frequency of application on rust infection, and (b) the relation between time of planting and rust infection; to enlarge the plantings of infected seedlings in order to increase data on survival of nursery-infected stock planted in the field; to remove oaks around nurseries in order to reduce nursery infections; and to cooperate with Federal and State agencies in giving advice and service.

2. In connection with the brown-spot needle blight it is planned to complete current laboratory tests and prepare a comprehensive report.

FOREST-PRODUCTS PATHOLOGY

The study of the distribution of stain fungi was extended to include isolations in north Mississippi and Georgia as well as in Louisiana. It was found that there was little difference in stain flora in the three States; that the seasonal distribution of certain stainers previously found in Louisiana held in Mississippi, but only partially in Georgia (Savannah); and that the marked differences in fungi that stain pine and hardwoods and the similarity of floras in logs and lumber previously found also held at the new stations. Field observations and a laboratory study of the growth and fruiting of stain fungi on wood and agar at constant temperatures indicated that high temperatures cause a decrease in incidence of certain fungi during the summer; this decrease was not evident at Savannah where summer temperatures are more moderate. A manuscript covering the work on the distribution of stain fungi has been prepared for publication.

Further studies on stain dissemination showed that air-borne spores are probably much more important than previously thought. It was evident, however, that inadequate methods were used in sampling air populations of spores of the important stain fungi, and the work was discontinued until new methods could be devised.

Isolations from about 200 insects collected in mill yards showed that almost any insect frequenting mill yards may carry stain fungi, but that only a relatively few insect species are important. The barkbeetles, *Ips*, *Orthotomicus*, etc., and the ambrosia beetles commonly carry spores of the important stain fungi. *Ceratostomella ips* was isolated from adults of *Ips* and *O. caelatus*, from newly made galleries of *Xyleborus*, and from the air. Previously this fungus was considered specific for *Ips*.

Several cases of the failure of commercial chemical methods to prevent staining were studied, and extensive isolations made from chemically treated wood. It was evident that these failures were due not to a specialized stain flora, but to poor handling practices; in most cases too long storage of logs and delayed dipping were the chief causes of failure. Delayed dipping is particularly serious in concentration yards, where the output of small mills is brought for dipping and seasoning.

Plans for 1939

The studies of chemical-control failures, of stain dissemination, and of the influence of mill and yard practices on the prevalence of stain fungi, will be continued.

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

FOREST-TREE INSECTS

Several endemic outbreaks of *Ips* barkbeetles were investigated. No epidemic outbreaks occurred in the Gulf States during 1938, and if fire is kept out of the forests there should be no serious outbreaks of barkbeetles. Large-scale summer cuttings have not led to epidemic infestations of barkbeetles, but in experimental plots, where the loss of a few trees by barkbeetles may seriously affect the results of a test, fall and winter thinnings should be practiced.

FOREST-PLANTATION INSECTS

A detailed plan of procedure for the control of leaf-cutting ants in plantations has been prepared for, and adopted by, the Region. Control consists of pouring carbon disulphide into the ant nests prior to planting the seedlings.

Silvicultural and chemical experiments were started on the Kisatchie National Forest for control of tip moths. Thus far very little infestation has occurred in the test area.

FOREST-NURSERY INSECTS

Insect damage to forest-nursery stock was very light during 1938.

The census of *Phyllophaga* (white grubs) of the Gulf region has been continued with 55 species recorded to date. An outbreak of white grubs in the Georgia State Forest Nursery at Albany was successfully checked by using carbon disulphide in the manner recommended by this Bureau.

FOREST-PRODUCTS INSECTS

Seventy-two chemical dips were tested at Tallulah, La., in cooperation with the Chicago Mill and Lumber Co., for control of ambrosia beetles in green lumber, but none of these chemicals was effective. Of twenty chemicals tested by spraying the lower half of green piles of lumber for control of ambrosia beetles, diphenyl gave most promising results. Tests showed that end-racking green lumber for 12 to 15 days will reduce the moisture content to a point where ambrosia beetles will not attack it.

Fifty-five chemical dips for control of powder-post beetles have failed in tests at Vicksburg, Miss. A new series of tests was begun in May 1938 at Tallulah, La., in cooperation with the Chicago Mill and Lumber Co. Eighty chemical dips are under test and 21 chemical sprays for piled lumber. Biological studies at Tallulah indicate that *Lyctus parallelopipedus* Melsh. develops from egg to adult in slightly over 3 months. Data indicate that *Lyctus* beetles will not attack boards having a moisture content of more than 15 percent.

A total of 110 termite-infested buildings treated with 19 different chemicals, eliminating duplications, are under observation in New Orleans, La., to determine the relative effectiveness and costs of various soil poisons. Of these 110 buildings, 36 were treated by this Bureau, using 12 different chemicals; 55 by commercial termite-control operators, using 8 different chemicals; and 19 by the owners, using 6 different chemicals. The re-inspections which have been made indicate that soil poisons are worthless without structural repairs, such as the removal of all wood that is in contact with the ground and pointing up poor mortar in foundations. Properly installed metal termite shields are proving effective for the types of buildings commonly constructed in New Orleans.

WOOD PRESERVATIVES AND CHEMICAL POISONS FOR FIBRE BOARDS

Inspections were made of tests conducted in cooperation with the Forest Products Laboratory and chemical companies to determine the effectiveness of various chemicals in preventing decay and attack of wood by termites, and new tests were installed.

Tests made in cooperation with manufacturers of fibre boards, using boards impregnated with chemicals to prevent decay and attack by termites, were inspected, and new tests were established. Arsenicals and chlorinated phenols show promise.

Plans for 1939

Current activities will be continued.

BUREAU OF BIOLOGICAL SURVEY

BIRD AND RODENT DAMAGE

As in previous years, the effect of birds and rodents on longleaf pine reproduction received primary attention. Little doubt now remains that birds are largely responsible for the destruction of what longleaf seed falls annually. The trapping of rodents was carried on to only a very limited extent during the year, and the number captured indicated a very meager population on cut-over longleaf pine lands of southern Mississippi.

The fall and early winter of 1938-39 in southern Mississippi was characterized by an abundance of longleaf pine seed, and by cold, blustery weather as early as the first of November. Apparently these two factors were responsible for the appearance of flocks of blackbirds two weeks or more ahead of their usual schedule. Roving flocks were common during the first week in November, when the food consumed consisted almost entirely of longleaf pine seed. It was of interest to note that, because much of the seed had not yet fallen to the ground, most of the birds were extracting the seed from the cones and were feeding therefore in the tops of the trees. A female red-winged blackbird collected on Nov. 7 from a flock of 30 of these birds had eaten nothing but longleaf pine seed, and from observations in the field this was also true of other blackbirds during this period.

As a basis for devising control measures for both artificial and natural reproduction of longleaf pine, experimental plots were established on the Harrison Experimental Forest at intervals of about 1 month during the late fall and early winter. The purpose of these plots is to determine the effects of ground cover and of sowing seed at different seasons on bird depredation and on the survival and germination of seed. Accordingly, areas which had been burned experimentally were selected to represent "roughs" of various ages up to 3 years. Beyond that period, it is believed that the growth of grass is too thick for satisfactory longleaf pine reproduction. The first sowing was made early in October on a 1-year "rough," and the last sowings will be made in the early spring of 1939. It is hoped that this experiment will indicate the time of year and the age of "rough" best suited to the survival and germination of longleaf pine seed.

Plans for 1939

Current studies will be continued, with emphasis on the development of control methods for minimizing bird damage to longleaf pine reproduction. Special attention will also be given to the relationship between bird and rodent damage and the abundance of the annual seed crop.

DISTRIBUTIONAL STUDIES

To increase basic knowledge of the bird and mammal life of the Gulf Coast region, distributional studies were carried on throughout 1938 as opportunity offered. Most of these studies were carried on in Mississippi and Louisiana, but some were also made in Georgia, Florida, and Texas. As in previous years, additions were made to the Natural History Collection at the Harrison Experimental Forest.

Plans for 1939

Current work will be continued.

PERSONNEL

SOUTHERN FOREST EXPERIMENT STATION

Jan. 1, 1938 - Dec. 31, 1938

DMINISTRATION

E. L. Demmon	Director
Oran Raber	Conservationist
John A. Lubbe	Sr. Adminis. Asst.
Vera S. Lind	Sr. Clerk
H. C. Bradshaw	Clerk
Marie M. Flad	Clerk-Stenog.
Agnes G. Terburg	Clerk-Stenog.
Helen Schweitzer	Asst. Clerk-Stenog.
Lillian E. Roane (transf. from U. S. Naval Air Sta. 3/1/38)	Jr. Clerk
Ventura J. Houpy (apptd. 6/13/38)	Jr. Multilith Operator
Iretta C. Austin	Telephone Operator

OREST MANAGEMENT

Arland L. MacKinney (deceased 7/4/38)	Sr. Silviculturist
W. G. Wahlenberg (transf. from Forest Economics 9/1/38)	Forester
Philip C. Wakeley	Silviculturist
C. Allen Bickford	Assoc. Silviculturist
Henry Bull	Assoc. Silviculturist
Roy A. Chapman	Assoc. Silviculturist
Eugene W. Gemmer	Assoc. Silviculturist
Theodore A. Liefeld	Assoc. Silviculturist
J. G. Osborne (transf. to Washington 11/3/38)	Assoc. Silviculturist
Louis J. Pessin	Assoc. For. Ecologist
Leslie R. Holdridge (transf. from Region 8, 4/1/38)	Assoc. Forester(CCC)
Carl F. Olsen (transf. to Flood Control Surveys 10/1/38)	Asst. Silviculturist
Alrick H. Antonie (transf. to Georgia Forest Service 2/16/38)	Jr. Forester(CCC)
Herbert H. Muntz (assigned from Region 8)	Jr. Forester(CCC)
*Mary L. Nelson (apptd. 10/1/38)	Jr. Plant Physiologist(CCC)
Truman E. Pease	Sr. Forest Ranger
Arthur L. Shepard	Asst. to Technician
*Thos. A. Hudgens (apptd. 3/15/38)	Asst. to Technician(CCC)
*R. C. Smith (apptd. 3/10/38)	Asst. to Technician(CCC)
Robert L. Brooks	Minor Asst. to Tech.(CCC)
Carl W. Cox	Minor Asst. to Tech.(CCC)
Chas. D. DeShazor	Minor Asst. to Tech.(CCC)
Lawrence E. Howard (resigned 9/30/38)	Minor Asst. to Tech.(CCC)
Henry W. Hughes	Minor Asst. to Tech.(CCC)
Jack B. Pearson (transf. from Region 8, 10/11/38)	Minor Asst. to Tech.(CCC)
Norman M. Scarbrough	Minor Asst. to Tech.(CCC)
Marquez J. Smith (resigned 7/6/38)	Minor Asst. to Tech.(CCC)
Ashley G. Williams	Minor Asst. to Tech.(CCC)

PUBLICATIONS

Jan. 1, 1938 - Dec. 31, 1938.

Bond, W. E. - The integration of forest industries in the southeastern United States. (Address delivered before annual meeting of the Southeastern Section of the S. A. F., Auburn, Ala., Jan. 7, 1938.) Jour. Forestry 36 (6): 549-554. June 1938.

______________ - Sustained yield costs and returns. Southern Lumberman 157 (1985): 129-133, illus. Dec. 15, 1938.

ull, Henry - Board-foot growth after improvement cutting. Southern Lumberman 157 (1985): 154-156, illus. Dec. 15, 1938.

urleigh, Thomas D. - The birds of Athens, Clarke County, Georgia. Occasional Paper No. 1 of the Georgia Ornithol. Soc. 35 pp. Feb. 1938.

______________ - The Mexican turkey vulture in southern Florida. The Auk. 55 (3): 520-521. July 1938.

______________ - The relation of birds to the establishment of longleaf pine seedlings in southern Mississippi. Occasional Paper No. 75. Southern Forest Expt. Sta. 5 pp., illus. July 27, 1938.

______________ - Second record of Brewer's blackbird in Alabama. The Auk. 55 (3): 545. July 1938.

hapman, R. A. - The effect of origin of stand on the site index of longleaf pine. Jour. Forestry 36 (1): 75-77, illus. Jan. 1938.

______________ - Errors involved in determining tree volumes by the planimeter method. Jour. Forestry 36 (1): 50-52, illus. Jan. 1938.

______________ - Applicability of the Z test to a Poisson distribution. Biometrika 30: 188-190, illus. June 1938.

raig, Ronald B. - Taxation of forest land in the Yazoo Delta of Mississippi. Occasional Paper No. 74. Southern Forest Expt. Sta., 43 pp. illus. July 23, 1938.

Cruikshank, J. W. - Forest resources of northwest Louisiana. Forest Survey Release No. 31. Southern Forest Expt. Sta. 21 pp., illus March 12, 1938.

________________ - Forest resources of the Ouachita Mountain region of Arkansas. Forest Survey Release No. 36. Southern Forest Expt. Sta. 27 pp., illus. Oct. 3, 1938.

________________ - Forest resources of southeast Oklahoma. Forest Survey Release No. 37. Southern Forest Expt. Sta. 25 pp., illus. Oct. 18, 1938.

________________ - Forest resources of northeast Texas. Forest Survey Release No. 40. Southern Forest Expt. Sta. 25 pp., illus. Dec. 22, 1938.

Demmon, E. L. - Forest research in the South. (Presented at meeting of the Cellulose Advisory Comm. for Perennial Crops of the National Farm Chemurgic Council at Chicago, Ill., April 6, 1938.) The Forestry News Digest Southern Issue, p. 15, May 1938.

________________ - Implications of paper industry expansion in the South. The Timberman 39 (6): 16-19. April 1938. Also in Forestry News Digest, Southern Issue, p. 28, May 1938.

________________ - Research results in Southern forestry. (Presented before the Texas Acad. Sci., Waco, Texas, Nov. 11, 1938.) Occasional Paper No. 77. Southern Forest Expt. Sta., 8 pp. Dec. 1, 1938.

________________ - The opportunity for forestry in Louisiana's Agricultural Program. In: Louisiana's Resources & Purchasing Power, La. Dept. of Commerce & Industry, pp. 93-100, illus. 193

Eldredge, I. F. - The hardwood forests of the lower South. Manufacturers Record 107 (2): 29-31, illus. Feb. 1938.

________________ - The timber wealth of the lower South. Southern Lumberman 157 (1985): 115-118, illus. Dec. 15, 1938.

(See also under Ineson and Winters.)

Faulks, E. B. - Growth and drain in the forests of central and southwest Mississippi. Forest Survey Release No. 34. Souther Forest Expt. Sta. 13 pp., illus. Aug. 11, 1938.

________________ - Forest resources in the longleaf pine region of Mississippi and east Louisiana. Forest Survey Release No 39. Southern Forest Expt. Sta. 34 pp., illus. Nov. 23, 1938.

*Heyward, F. D. - Soil temperatures during forest fires in the longleaf pine region. Jour. Forestry 36 (5): 478-491, illus. May 1938.

*Huberman, M. A. - Growing nursery stock of southern pines. U. S. Dept. Agr. Leaflet 155, 8 pp., illus. April 1938.

Ineson, F. A. - The use of round turpentine timber—surveys in the several states and conclusions drawn from them. Gamble's Internat. Naval Stores Year Book for 1938-39. pp. 135-137, illus. 1938.

________ and Eldredge, I. F. - Forest resources of northeastern Florida. U. S. Dept. Agr. Misc. Pub. No. 313. 40 pp., illus. Aug. 1938.

Liefeld, T. A. - Naval stores yields from French and American faces chipped on bark-bars. Gamble's Internat. Naval Stores Year Book for 1938-39. pp. 130-131, illus. 1938.

________ V. L. Harper* and - A new day in the naval stores industry. Jour. Forestry 36 (11): 1128-1130. Nov. 1938.

Meginnis, H. G. - Effect of depth of sowing on nursery yields of black locust. Jour. Forestry 36 (4): 411-416, illus. April 1938.

________ - The pole-frame brush dam—a low-cost mechanical aid in reforesting gullied land. Occasional Paper No. 76. Southern Forest Expt. Sta. 8 pp., illus. Aug. 15, 1938.

Nelson, Mary L. - Preliminary investigations on dry, cold storage of southern pine seed. Occasional Paper No. 78. Southern Forest Expt. Sta. 19 pp. Dec. 8, 1938.

Olsen, C. F. - Studies in fire behavior at the Southern Forest Experiment Station. Mississippi National Forests. Fire News 2 (17): 2-3. May 1938.

________ - Technique for evaluating the vigor of planted slash and longleaf pine seedlings. Jour. Forestry 36 (7): 702-704, illus. July 1938.

Osborne, J. G. - Effects of burned faces on later turpentining. Forestry News Digest. Southern Issue, p. 23. May 1938.

Pessin, L. J. - Effect of soil moisture on the rate of growth of longleaf and slash pine seedlings. Plant Physiol. 13 (1): 179-189, illus. Jan. 1938.

________ - The effect of vegetation on the growth of longleaf pine seedlings. Ecol. Monographs 8 (1): 115-149, illus. Jan. 1938.

Raber, Oran. - The history of shipmast locust. Jour. Forestry 36 (11): 1116-1119. Nov. 1938.

Reynolds, R. R. - Possible returns from planted loblolly pine. Occasional Paper No. 73. Southern Forest Expt. Sta. 8 pp. Jan. 31, 1938.

________________ - Studies in shortleaf pulpwood production. Southern Lumber Jour. 42 (2): 24, 59. Feb. 1938. Also under title: "Studies of pulpwood production in shortleaf-loblolly pine stands." Paper Trade Jour. 106 (17): 64-65. April 28, 1938.

________________ - Forest research as applied to south Arkansas. (Presented before Third Cooperators Meeting, Little Roch, Ark., June 20, 1938.) Proc. Third Annual Meeting Ark. For. Commission Cooperators. 28-34. June 20, 1938.

________________ -The business side of conservation. (Presented at Assoc. of Paper Mill Superintendents, Southern Division, Monroe, La., Nov. 4, 1938.) Southern Pulp and Paper Jour. 1 (1): 26, 35, 36, illus. Dec. 1938.

Snyder, T. E. - The termite problem and recent research. (Presented before National Pest Control Assoc. Memphis, Tenn., Oct. 25, 1937.) Exterminators Log 6(3): 6-9, illus. March 1938.

________________ - Isoptera, family Rhinotermitidae, *Reticulitermes creedei* n. sp. A new fossil termite from the Miocene. In: Carpenter, F. M., and others, Fossil insects from the Creede Formation, Colorado. Psyche 45 (2-3): 109-110, illus. Sept. 1938.

________________ - The present status of the *Lyctus* problem. Year Book National Hardwood Lumber Assn. pp. 84-90, illus. Oct. 1938

Southern Forest Experiment Station - Southern Forestry Notes No. 20, Jan. 1938.

________________ - Southern Forestry Notes No. 21, March 1938.

________________ - Southern Forestry Notes No. 22, May 1938.

________________ - Southern Forestry Notes No. 23, Sept. 1938.

________________ -Southern Forestry Notes No. 24, Nov. 1938.

Spillers, A. R. - Forest resources of northwest Florida. Forest Survey Release No. 33. Southern Forest Expt. Sta. 33 pp., illus. June 18, 1938.

__________ - Forest resources of southwest Alabama. Forest Survey Release No. 35. Southern Forest Expt. Sta. 35 pp., illus. Sept. 9, 1938.

__________ - Forest resources of central and south Florida. Forest Survey Release No. 38. Southern Forest Expt. Sta. 30 pp., illus. Nov. 3, 1938.

Stover, W. S. - Sawtimber and cordwood volumes in north Georgia. Forest Survey Release No. 30. Southern Forest Expt. Sta. 8 pp., illus. Feb. 10, 1938.

Wahlenberg, W. G. - Profitable management of shortleaf and loblolly pine for sustained yield. U. S. Forest Service Bull. 22 (9): 3-4. May 2, 1938.

Wakeley, Philip C. - Harvesting and selling seed of southern pine. U. S. Dept. Agr. Leaflet No. 156. 8 pp., illus. April 1938.

__________ - Planting southern pines. U. S. Dept. Agr. Leaflet No. 159. 8 pp., illus. June 1938.

Winters, R. K. - Forest resources of the north Arkansas Delta. Forest Survey Release No. 32. Southern Forest Expt. Sta. 21 pp., illus. April 16, 1938.

__________ - Fuelwood consumption in the Lower South. Forestry News Digest. Southern Issue, p. 21. May 1938.

__________ *Putnam, J. A., and Eldredge, I. F. - Forest resources of the North-Louisiana Delta. U. S. Dept. Agr. Misc. Pub. No. 309. 49 pp., illus. Aug. 1938.

*Major portion of work on paper completed while a member of the Station staff.

Unpublished Addresses

Chapman, R. A. - Some illustrations concerning the theory and application of the analysis of variance. Annual Meeting New Orleans Acad. Sci., March 25, 1938.

Craig, R. B. - Drainage district taxation as a public problem. Annual Meeting New Orleans Acad. Sci., March 25, 1938.

Demmon, E. L. - The need for forestry in the nation and in Texas. Conservation Course, North Texas State Teachers' College, Denton, Texas, July 8, 1938.

Eldredge, I. F. - Forestry in relation to land utilization. Soil Conservatio and Land Utilization Section of the Agricultural Program Planning Conference, Baton Rouge, La., April 7, 1938. Also before Georgia Forestry Assoc., Valdosta, Ga., April 21, 19

——————— - Forest resources of the lower South. Regional Meeting Assoc. American Colleges, Hendrix College, Conway, Arkansas, Nov. 10-12, 1938.

Ineson, F. A. - Sociological aspects of forest land use. New Orleans Soc. Plant Sciences, Jan. 31, 1938.

Johnston, H. R. - Nursery insects. Nursery Conference, Albany, Ga., Aug. 1, 1938.

MacKinney, A. L. - Growing southern pine pulpwood. Louisiana Section of the American Chem. Soc., Bogalusa, La., May 21, 1938.

Muntz, H. H. - Soil amendments and their effect upon growth and development of southern pine nursery stock. Nursery Conference, Albany, Ga., Aug. 1, 1938.

Nelson, Mary L. - Current developments in the storage of southern pine seed. Annual Meeting New Orleans Acad. Sci., March 25, 1938.

Osborne, J. G. - A study of the properties of oleoresin from longleaf pine. Annual Meeting New Orleans Acad. Sci., March 25, 1938.

Siggers, Paul V. - Cronartium in nursery and plantation. Nursery Conference, Albany, Ga., Aug. 1, 1938.

Turner, Lewis M. - The relation of geological formations to the distribution o vegetative types in Arkansas and Texas. Annual Meeting New Orleans Acad. Sci., March 25, 1938.

Wakeley, Philip C. - Factors affecting the rate of sowing in forest nursery seed beds. Nursery Conference, Albany, Ga., Aug. 1, 1938.

Note: Assistance in the preparation of these materials was furnished by the personnel of Works Progress Administration Official Projects 701-3-9 and 365-64-3-

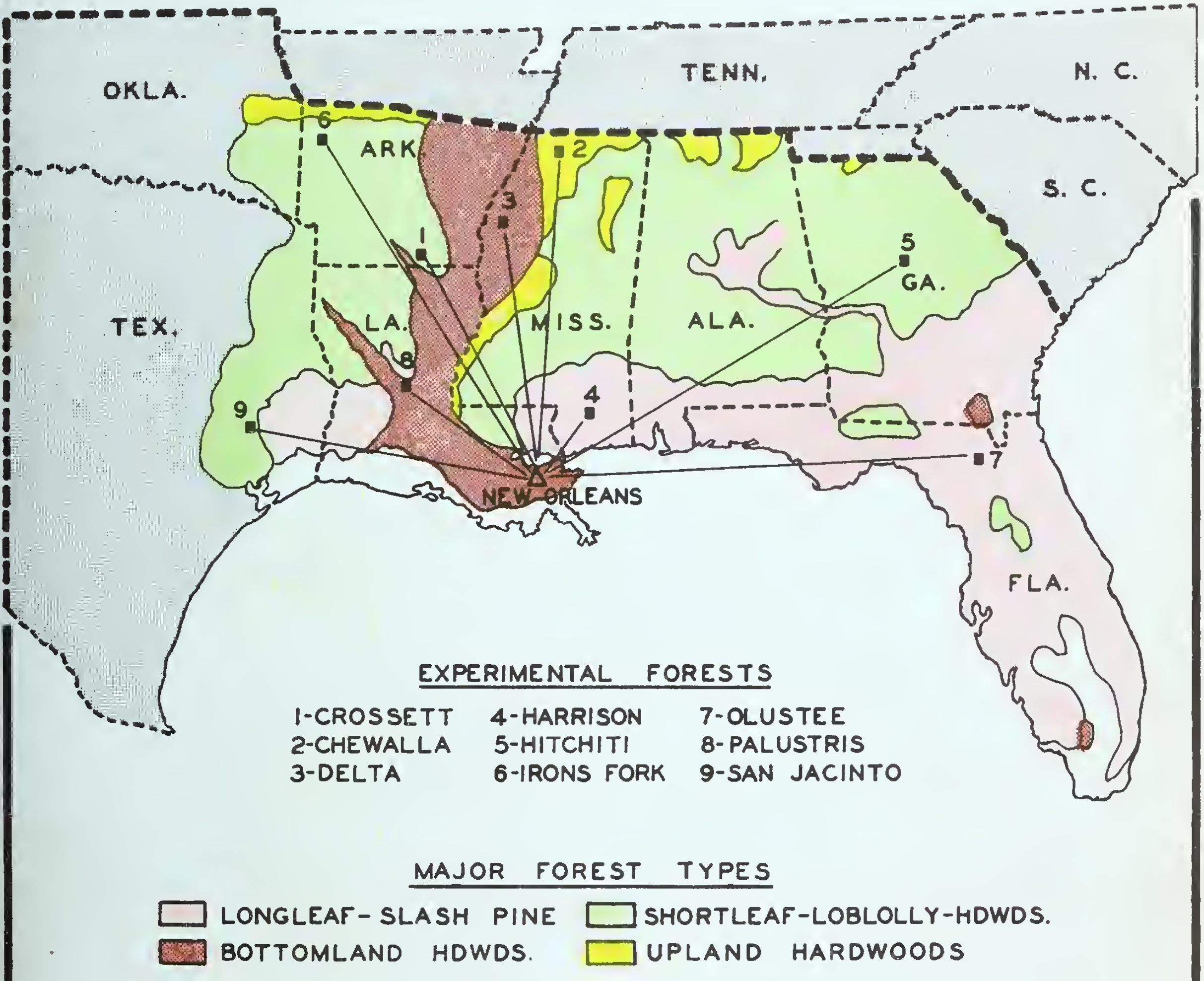
3.27

CULTURAL REFERENCE DEPT.
CLEMSON COLLEGE LIBRARY

19TH
ANNUAL REPORT
SOUTHERN FOREST EXPERIMENT STATION

E. L. DEMMON, DIRECTOR
NEW ORLEANS, LA.

1939



EXPERIMENTAL FORESTS

1-CROSSETT	4-HARRISON	7-OLUSTEE
2-CHEWALLA	5-HITCHITI	8-PALUSTRIS
3-DELTA	6-IRONS FORK	9-SAN JACINTO

MAJOR FOREST TYPES

☐ LONGLEAF-SLASH PINE	🟩 SHORTLEAF-LOBLOLLY-HDWDS.
🟥 BOTTOMLAND HDWDS.	🟨 UPLAND HARDWOODS

CONTENTS

Page

Introduction 1

Current investigations:

- Forest management 8
- Forest influences 12
- Flood control surveys 16
- Forest economics:
  - Taxation 17
  - Private forestry 18
  - Forest survey 20
- Cooperating agencies:
  - Bureau of Entomology and Plant Quarantine 22
  - Bureau of Plant Industry 23
  - Bureau of Biological Survey 24

Personnel 25

Publications 29

- Unpublished addresses 35

NINETEENTH ANNUAL REPORT

of the

SOUTHERN FOREST EXPERIMENT STATION

January 1, 1939 - December 31, 1939

INTRODUCTION

Present forest situation in the Lower South[1] unsatisfactory

The Lower South is not enjoying fully the opportunities offered by its forest lands. The Forest Survey has shown that more than 120 million acres or almost 60 percent of the land area in the Lower South is productive forest land, capable of growing profitable crops of timber under forest management. It found a sound-tree growing stock of usable sawtimber amounting to 254 billion board feet, lumber tally, plus 852 million cords of material under sawlog size. It also has shown, however, that the present forest is greatly understocked, producing less than half the timber of which the sites are capable, with many thin stands made up of limby trees of poor quality and low value, large numbers of them fire-scarred, and more than 9 million acres of land practically devoid of tree growth.

This debilitated condition can be laid to a variety of causes, chief of which are the long-sustained practice of over-cutting and of removing the best trees and leaving the poorest, together with widespread and frequent burning-over of most southern forest areas. The Lower South's advantages of an immense area where soil and climatic conditions are favorable for rapid tree growth, the great number of valuable native tree species, the ease of logging, the availability of ample labor, and accessibility to good markets, offer the extraordinary opportunity of making this region the most important source of future timber supplies for North America. A big job lies ahead, however, in rebuilding this great natural resource to maximum usefulness.

The Lower South originally had the most extensive body of valuable timber to be found in the world. Less than 15 percent of the original area is occupied by old-growth forest stands, and more than half of this remainder has been partially cut. The day of lumber production based on liquidation of virgin forest stands is over. For the past several years, more than half the lumber produced in the Lower South has come from second-growth stands, and that proportion is steadily increasing. By and large, this second crop of timber has come up with very little care or attention.

---

[1] In this report, the Lower South is approximately that section within the boundaries of the Southern Forest Experiment Station territory and includes the States of Georgia, Florida, Alabama, Mississippi, Louisiana, southern Arkansas, east Texas and east Oklahoma (see map on front cover).

Within the last decade, however, considerable progress has been made in the adoption of conservative forest management practices. A Forest Service investigation (1938) indicated that over 13 million acres of commercial forest land in industrial and other ownership (not including farm ownership) in the Lower South is being managed with the object of continuous production.

Part of this progress is accounted for by the recent phenomenal expansion of pulp and paper mills in the South, including completion early in 1940 of the first mill to make newsprint from southern pine. These pulp and paper mills have purchased more than 3 million acres of forest land in the Lower South, on which a considerable part of their raw material requirements is being grown. The company holdings, as a rule, are managed by technically trained foresters, with sustained yield from fully built-up forest stands as the objective. Such mills afford a market also for material from even larger areas of non-company lands that has heretofore had little or no value and has generally been unutilized in the woods. Furthermore, this forest industry is the first in the South to adopt voluntary forest conservation practices, both on its own lands and on the lands of those from whom it buys wood. Although full compliance with its conservation rules has not yet been attained, the pulp and paper industry has made good progress towards better forestry through setting up minimum cutting standards—not all that could be desired for intensive forestry practice, perhaps, but a decided step forward.

Lumber companies and smaller landowners, too, are making progress in placing more forest land under organized fire protection, in conservative cutting practices, in thinning dense stands, and in restocking of denuded lands by planting. There has been a marked increase in ownership of land by public agencies, both Federal and State, which means placing more land under sustained-yield management.

Many perplexing forestry problems

In spite of these evidences of progress, much remains to be done before the South's forests will be contributing their full share toward the economic and social advancement of this region. Even at this present day, about 20 percent of the forest lands in the Lower South is burned over each year; furthermore, less than 40 percent of the forest land in the region is under organized fire protection. It is estimated that about 10 million acres of southern forest lands are in need of forest planting, yet to date only about 500,000 acres have been planted, and not all this with complete success. The combined planting program of public and private agencies contemplates the reforestation of between 75,000 and 100,000 acres annually during the next few years—rather slow progress considering what needs to be done.

About 93 percent of the forest lands of the Lower South and 95 percent of its sawtimber volume are in private ownership. Of the huge area of privately owned land, over 37 percent is on farms. The problem of getting good forestry practiced on these lands is complicated by the mixed pattern of land ownership involving millions of individuals, many of them absentee owners. About 60 percent of southern farmers are tenants and about 40 percent of the tenants move every year. The need for ready cash is so urgent to most small forest owners that they are often willing to forego future returns for a little immediate revenue. This instability of farm tenure is one of the greatest deterrents to good forestry practice on farm woodlands.

Another big hindrance to forestry progress can be charged to the small portable sawmill. Over 90 percent of all southern sawmills are in the small-mill classification (under 20,000 board feet daily capacity); they cut more than 50 percent of the lumber produced in the Lower South. Mills of this class are essential in the flow of lumber from stump to market, and without them many thousands of small timberland owners could find no immediate outlet for their forest products. On the other hand, these small mills, in general, do not contribute to good forestry practices. The typical small mill operator owns no timberland, takes little or no part in encouraging timber growing on the other man's land, and generally cuts every tree that will make a 2x4, thus stripping the land of growing stock. In the main, small mills manufacture an inferior product, pay minimum wages, buy their logs at prices which offer no incentive to the growing of timber, and contribute to the current over-production of low-quality lumber. The operators of these transient plants are apparently impervious to all efforts to interest them in better forest and utilization practices.

Good forestry is not possible without good markets, and because of the tremendous forest area and favorable conditions for forest growth in the Lower South, more and broader outlets for forest raw material are needed. With increased markets will come keener competition and increased prices for stumpage, enhancing the profitableness of timber growing. In the past, the South has furnished large quantities of lumber and other roughly manufactured wood products to the North and Midwest. What it needs now is more remanufacturing plants (such as furniture factories, wood fabricating industries, plywood plants, etc.) and additional forest industries employing a higher degree of processing to absorb more local labor, and to produce more consumer goods.

In 1937, the forests of the 8 States in the Lower South furnished raw material for more than 10,000 industrial plants using forest products, and provided nearly 60 million man-days of employment (42 percent in the woods and 58 percent in the plants). A portion of this labor was employed on a part-time basis, but it is conservatively estimated that over half a million persons obtained all or a major part of their livelihood directly from the forests or the wood-products plants of the region. After some decades of proper protection and management, the forests of the Lower South could support almost double this number of workers on a stable and permanent basis.

The South is a section of the Nation with large and pressing social problems—a land of declining agriculture, where farming has heretofore been the main source of livelihood. The area in cultivation has been shrinking for more than a decade until there is less crop land now than 80 years ago; furthermore, the soil has deteriorated greatly during that time, whereas rural population has about doubled. Forty-five out of every hundred acres of farm land is now in forest, and these forest lands take up 13 times as much area as does cotton, the crop ranking second to timber in terms of land use. Cash income from these farm woodlands (according to the 1930 census) averaged only 16 cents per acre, whereas under good forest management, an annual gross income of $2 to $3 per acre, including an outlet for the farmer's own between-crops labor, would be possible.

Owing to the decline of agriculture coupled with a steady increase in population, incomes have decreased, and the South has become, according to the National Emergency Council, the Nation's Economic Problem No. 1. Considering its resources in land, climate, and population, it might well become the Nation's No. 1 customer, and at present the international situation suggests that the United States must look for home markets to absorb losses in foreign trade. Much of its lands are best suited for agriculture, other areas will be available for intensive mineral development, but by far the greater part of the land surface should be utilized for forest production, its highest use. Full development of these forest resources will provide permanency to communities and industries, continuous employment of labor, more prosperous railroads and other utilities, a broader and more stable tax base, and through increased purchasing power will give the people of the region that parity in prosperity they have long been denied.

Where does forest research fit into the picture?

What can be done to promote better forestry practice in the South? One major need is for more forestry education to reach more people. Instead of a single extension forester to a State, each county, especially in the heavily-forested sections, should have a publicly employed forester, working in close cooperation with the county agricultural agent. Lack of practical, working knowledge of the full possibilities of good forest husbandry and of what it promises in dollars and cents returns has undoubtedly held back progress.

It is only in recent years, however, that preliminary information on which to base sound forestry recommendations has become available. Even now, much vital information essential for permanent, successful forest-land management, which can best be derived through forest research, is entirely lacking. In general, forest research is a job for the public agencies; first, because it is inefficient for each landowner to undertake, alone, research for his individual land; secondly, because the public is by far the largest single owner of forest land; and finally, because in a long-time undertaking such as forest research, public agencies alone can be expected to provide the necessary continuity of effort and stability of program.

Forest research at the Southern Forest Experiment Station, the regional Federal station serving the Lower South, was initiated on a small scale in 1921. Since then, its program has been expanded gradually and, within the limitations of its facilities, it has sought answers to many problems of forest protection and management and of forest-land use confronting this region. Its nine experimental forests, set aside on publicly owned land, and representative of the major forest types of the Lower South, serve primarily as field laboratories for conducting fundamental and applied forest research, but they also are used extensively as demonstration areas, where lumbermen and others can see, on the ground, the results of recommended forest practices. Highlights of current Station findings are presented later in this report.

Since 1921, the Station has made noteworthy progress in working out the scientific basis for good forest management, but forest research is necessarily a long-time undertaking. This is particularly true in the Lower South, where more than 120 million acres of forest extends over eight States from the Atlantic Ocean to the plains of Texas, and the research worker encounters a complexity of forest soils, forest types, and conditions, a great variety of forest products, and a multiplicity of uses for forest lands. In order to increase the quantity and quality of forest products on southern lands, research is helping to find the answers to many questions, including the following.

1. How can proper forest management be attained?

Many complicated problems face the landowner interested in improving his forest. How should he manage his forest for sustained production? This is an all-important question, whether the forest extends over several hundred thousand acres or is only a small patch of timber on a farm. The owner needs to know when to cut his trees and which ones should be removed and which left standing, to insure maximum growth and yields; which trees are needed as a source of seed to obtain natural reproduction; how open, understocked stands can be brought to full productiveness; how the more valuable species can be favored and the less valuable eliminated (through cutting, girdling, poisoning, burning, etc.); when and to what extent young stands can be thinned or improvement cuttings made advantageously; when pruning is justified, and how and when it should be done; what planting methods can be used on eroded or waste lands to bring them back to productivity; what turpentining practices (in the longleaf and slash pine belt) will give maximum gum yields with a minimum of damage to the trees; and many other questions that must be answered for each of the many forest types and for different objectives of management—with the necessity for showing a profit always in mind.

2. How can forests best be protected?

Southern forests are subject to losses from fire, animals, insects, disease, storms, etc. To provide adequate protection from such losses, these influences must be studied and plans developed for measures to control or modulate their effects, with speed and efficiency, and at minimum cost. Control measures will differ according to variations in soil, climate, timber type or vegetative cover, age and condition of stand, etc. Of all the enemies of southern forests, fire is considered the most dangerous. Adequate control of fire, therefore, is the first essential to the practice of forestry in the South.

3. Will forestry pay?

Another group of problems revolves around the economic aspects, or the costs and returns of forestry. What forestry practices pay; which are unprofitable; which, although at present unproductive, will probably return a future profit? What combination and sequence of forest utilization measures will produce the greatest profit per acre in the long run? How much investment should the landowner or manufacturing establishment make in land, in timber, in utilization roads, in logging equipment, in plant, etc.? What marketing practice offers most favorable returns? What opportunities exist for obtaining long-time forest credits at reasonable interest rates? Is the forest tax situation favorable or unfavorable, and what is the outlook for any change in this respect? What is the over-all forestry situation in any given community or economic unit, and in the region as a whole, as respects timber resources, present rates of depletion and regrowth, and the probable future markets for its wood and forest products? A sound forestry program should be based upon the management and utilization of the forest resource in the best interests of the individual, the community, and the Nation.

4. What can be done to obtain more and better utilization of forest products?

Profitable forestry frequently depends on developing new uses or new markets for products at present unmerchantable. For example, over 50 percent of the volume of southern forests is in hardwoods, much of it in low grade or cull trees and in so-called "inferior" species, at present unmerchantable. Also, many southern pine forests are reverting, through cutting out of the pine component, to inferior quality hardwoods. This situation presents many problems requiring the help of utilization research.

Present stands of second-growth longleaf and slash pine exceed the needs of the naval stores industry in supplying their present or prospective markets. The supply of stumpwood will more than take care of prospective demands for wood naval stores products for a long time to come. In both these cases research aimed to expand the markets for turpentine and rosin is called for.

Many of the methods of logging and processing used in southern forests are wasteful and inefficient. Studies are needed to improve logging methods and equipment, and to obtain more efficient operation of sawmills, particularly small mills.

Many unsolved problems confront the pulp and paper industry, wood distillation plants, treating plants, and other forest utilization enterprises throughout the South. This region urgently needs more manufacturing industry, and one outstanding possibility for such development lies in finding new uses for wood products and higher degrees of fabrication or processing for the forest resource, a job for forest utilization research.

5. How and to what extent can supplementary forest resources such as grazing, wildlife, and recreation best be developed?

Southern forests offer many resources other than timber. Most southern forest lands provide some grazing for livestock. For the most part, the forest range is unfenced and is used at no cost by small cattlemen and farmers who customarily set winter fires to improve the forage. This interferes seriously with the use of the land for timber growing. Research is needed to take full advantage of the opportunity of utilizing southern forests for grazing, together with other uses. This calls for coordination in the fields of forestry, range management, animal husbandry, agronomy, and economics.

The possibilities offered by southern forests for the propagation of wildlife are almost unexplored, although valuable investigations have been made on quail in the Southeast. The occupancy of forest land by game animals presents numerous unsolved problems in land management.

There is also need for correlating uses of southern forests for timber, livestock, and game with their use for outdoor recreation.

6. What influence do forests exert on streamflow, erosion, and flood control?

The generally beneficial influence of forest and vegetative cover in holding the soil has long been recognized. It is far from certain, however, how much influence forests exert in regulating streamflow, or in preventing floods and the silting of streams and reservoirs. If it is proven that forestry can play an important role in ameliorating these conditions, the public can be saved enormous losses annually. What we need is more exact knowledge of these forest influences, as a basis for proper land management, and this can best be obtained by a carefully planned and conducted research program.

Summary

Although considerable progress in forestry has taken place in the Lower South during the last two decades, one reason for slowness in adopting good forestry practices can be laid to insufficiency of technical knowledge. Research must supply this information unless we are to use the inefficient and costly trial-and-error method. The U. S. Forest Service through its program of forest research in the Lower South has made a fair start in finding the answers to many of the questions stated above. In this program, it has tried to find solutions to the most important problems first. It has already helped to point the way toward better and more profitable forestry practices in this region. Progress reports have been issued from time to time and distributed to southern forest landowners and public agencies. The Station territory is so extensive, however, the forest types and conditions so varied, and the problems requiring answers so numerous, that the facilities available have been entirely inadequate to do more than scratch the surface. As an example, almost no research has been possible in the southern bottomland hardwood region, although this is the greatest source of hardwoods in the United States. To obtain the basic scientific information needed for the best development of one of the region's foremost resources, its forests, there is need for several fully-equipped and well-manned Federal forest experiment stations in this section, each supplied with ample facilities in the form of experimental and demonstration forests, technical personnel, and equipment. In view of the importance of developing fully the region's greatest potential source of wealth, and in order to help solve its many complex social and economic problems, a greatly expanded program of forest research can be completely justified.

The following pages set forth several research accomplishments of the Southern Forest Experiment Station for the past year, together with a resumé of plans for the future. These highlights are separated according to the four main divisions of Station investigations: (1) Forest Management, (2) Forest Influences, including Flood-control Surveys; (3) Forest Economics, and (4) the Forest Survey.

FOREST MANAGEMENT

Bottomland hardwood research started

Forty-two percent of the alluvial valley of the Mississippi River from the Ohio River to the Gulf of Mexico is forested, covering a total of 13-1/2 million acres. The bottomland hardwoods in this region constitute an important part of the South's extensive forest resource. In addition, there are 15 million acres of bottomland hardwoods scattered through the remainder of the South. Until this year, however, no research to determine proper methods of managing bottomland hardwood forests had been undertaken.

A study of different methods of improving a typical, poorly stocked, second-growth stand of bottomland hardwoods was started in the fall of 1939, in cooperation with the Mississippi Agricultural Experiment Station at the Delta branch station near Stoneville, on forest land that had previously reverted to the State for non-payment of taxes. While this tract does not contain enough trees to occupy the site fully, it contains far too many poor trees—trees that are diseased and insect-ridden, trees of unmerchantable species, and trees of poor form and low quality. Unrestricted fires and trespass have caused great losses. This condition, unfortunately, is common in the bottomland hardwood section; hence the Stoneville stand is particularly suitable for the study.

Two degrees of improvement cutting are being tested, and the results of each will be compared with those for unimproved stands. Only the poorest trees are being removed, but with so many such trees the cuttings are heavy. Most of the trees cut are suitable only for fuelwood, but sawlogs and stave bolts are being cut wherever possible. A complete record of costs and returns is being kept. In addition to determining the immediate financial outcome of these improvement cuttings, and the subsequent growth of the differently treated stands, it is planned to use this study to develop general marking rules suitable for use throughout the Delta region. The demonstration value of this study is also being developed to the greatest extent possible.

Advances made in study of pine nutrition.

Little is known of the nutritional requirements of the southern pines. A study devised to explore this field has been resolved into two phases: (1) the effect of nutrient deficiencies on the vigor of pine seedlings, and (2) the optimum and minimum nutrient requirements of pine seedlings. The first part of the study has been completed, while the second is still in progress.

The study revealed that during the first year of growth, deficiencies of some elements bring about highly detrimental results, while the lack of other elements shows little or no injurious effects. Nitrogen deficiency is definitely injurious to all southern pine species, scarcely any needles being produced by shortleaf, loblolly, and slash pine when grown in the absence of nitrogen. Longleaf pine produced needles distinctly shorter than in the other cultures.

Deficiency of potassium showed definite injurious effects on slash, loblolly, and shortleaf but little effect on longleaf pine. Absence of calcium showed no definite effects on any species, except loblolly pine, in which root development seemed to be hindered. Although magnesium deficiency reduced the vigor of longleaf pine seedlings, the effect on the slash, loblolly, and shortleaf pines was small. Shortleaf pine alone showed injury from sulphur deficiency. Lack of phosphorus showed no adverse effects on any pine species. The needles were a healthy deep green color and vigor was not markedly different from those growing in cultures supplied with all the nutrients.

Root competition an important factor in retarding early growth of longleaf

Longleaf pine seedlings exhibit many unique growth characteristics. For a period following germination, the stem grows extremely slowly and is scarcely visible above ground. Duration of this period of slow growth depends on several factors including site, heredity, and the frequence and severity of insect and disease attacks. It may extend to 15 years, and 10 years is common. Recent studies have shown that another factor, competition for nutrients, plays an important part in this period of stagnation. Longleaf pine seedlings grown in containers without grass showed an average dry weight greater than when grass was present. Where the grass was removed, burned, and the ashes returned to the container the dry weight of the pines was intermediate between those growing without grass and those growing with grass left undisburbed. Inasmuch as ample water was applied to the cultures, it appears that the root competition between grasses and pines was not for water alone, but to a large extent for mineral nutrients also. Such competition for mineral nutrients is probably important in the soils of the Gulf Coastal Plain where soil fertility is limited.

Fertilizer studies confirm current nursery practice

The earliest pine tree nurseries in the South were operated on a kind of "shifting agriculture;" investments in buildings and other improvements were kept small, and when several crops of pine seedlings had depleted the soil, nurseries were moved to new ground. After the launching of ambitious State and Federal planting programs about 1933 to 1935, however, a number of large nurseries were permanently established, with large investments in buildings. Consequently, the operating agencies faced the problem of maintaining soil fertility at the original sites. Since then, many have adopted the alternation of one crop of pine seedlings with one green manure crop, usually a legume, as a means of maintaining or increasing fertility.

Following the adoption of this practice, questions have arisen as to whether results justified costs of seed, cultivation, and doubled area of nursery required. An affirmative answer is indicated by a study of nursery crop rotations inaugurated by the Station in 1935, at the Stuart Forest Nursery in Louisiana. In this study six treatments are applied separately to beds of longleaf and of slash pine seedlings, with suitable replication. Beds of each species are devoted to: (a) pines annually, with no fertilizer; (b) pines annually, with "6-10-7" commercial fertilizer; (c) pines alternated annually with unfertilized cowpeas; (d) pines alternated annually with fertilized cowpeas; (e) pines two years, followed by one year of unfertilized cowpeas; and (f) pines two years, followed by one year of fertilized cowpeas.

Moderate fertilization greatly increases the growth of the cowpeas and the bulk of green manure available for turning under. The marked superiority of the pines in treatment f, following the plowing under of only one season's crops of fertilized cowpeas, as compared with the unfertilized pines on the depleted soil of treatment a, showed the essential soundness of green manure crops. In addition, since the start of the study, the pines grown after green manure crops have been less subject to chlorosis and other maladjustments than the pines given commercial fertilizer but no alternation with leguminous crops.

Forest fire danger meter for the longleaf-slash pine type

Suppression of fires in the longleaf-slash pine type requires rapid and efficient action, if the burning over of enormous areas is to be prevented, especially when the fire danger is high. A fire danger meter was prepared in 1939 to assist the forest officers in organizing manpower and equipment most effectively in periods of bad fire weather.

This meter is based on a study of rate-of-spread of fire and indicates probable rates of spread without a direct measure of the probability of fires occurring. It recognizes five danger classes: none, low, normal, high, and extreme. These classes of fire danger indicate progressive steps necessary in fire suppression organization. Fire danger is the dependent variable and wind velocity, moisture content of the basswood indicators, and herbaceous stage are the independent variables. The meter is made in the form of a continuous-function slide rule.

Fire discovery time explored

Fires in the longleaf-slash pine type spread so rapidly that fire suppression action must be exceptionally prompt. Discovery time in this type has therefore a much greater effect on final size than where fires spread more slowly. The measurement of discovery time and of its dependence on other factors, such as visibility, is consequently of great potential value to fire protection organizations.

A study was undertaken in 1939 to determine the possibility of estimating the length of the period from the origin of a fire to the time of first discovery. It was found that the length of this period varies with changes in rate of spread, visibility distance, and distance from the fire to the lookout. The results of the study have been presented as an alinement chart which gives an estimate of discovery time.

Chemical treatments promise increased naval stores yields

During the past 15 years the Southern Station has been instrumental in promoting improved naval stores practices to conserve timber and increase yields, thereby directly affecting harvesting costs. Further advances have recently been made through the completion of a study in which various chemical solutions were applied to the streak immediately after chipping to stimulate gum production. Of the chemicals so far tested sulphuric and hydrochloric acids, in relatively weak solutions, both show considerable promise of increasing the yield of gum from a streak when applied in some simple way such as daubing with a cotton dauber. Average gum production of streaks treated with 20 percent sulphuric acid was increased 25 to 70 percent. Chemical treatment appears more effective on slash pine than on longleaf. The cost of the chemicals is practically negligible because of the dilution with water and the small amount of solution required per tree. Moreover, the labor required to apply the solution is only a small fraction of that required for chipping. From the relatively small amount of work already done it is evident that chemical reagents offer considerable promise in naval stores extraction practice.

Desirable frequencies of chipping for naval stores

During 1939 a series of studies aimed at the determination of desirable frequency of chipping for naval stores production were analyzed and summarized in a manuscript entitled, "Relation of Naval Stores Yields to Frequency of Chipping." It was found that weather, particularly air temperature, largely determines the rate of gum production from a streak, and that winter chipping as well as chipping more frequently than once a week for short periods in the summer is not detrimental to total yields over a period of years.

From this information, chipping frequency schedules, such as those summarized briefly in the following statements, have been formulated to meet various economic and silvicultural objectives: Frequent chipping, up to a maximum of 3 streaks a week during the summer and every other week during the winter, is desirable for quick exploitation of naval stores, for example, prior to a thinning or sawlog harvest. When longer working life is considered more important than higher production per year, chipping twice a week in the summer, weekly in the spring and fall, and twice a month in the winter is desirable. If a varying interval between streaks cannot be put into practice, customary weekly chipping from March to November and twice a month during the winter is desirable.

Resumé of plans - 1940

Forest management research for 1940 will carry out in general the program followed during 1939. Emphasis will be placed upon the development of experimental forests to meet more adequately the needs of the region for experimental and demonstrational areas in the field of forest management.

In the field of silviculture, research in bottomland hardwood types will again be given principal attention. Stand improvement and regeneration studies undertaken in 1939 will be carried toward completion. Additional stand improvement studies and experiments in natural regeneration in hardwoods will also be undertaken. All field work will be concentrated on the lands of the Delta Experiment Station at Stoneville, Miss.

In the field of pine silviculture, the Olustee Management Plan will be developed according to schedule, this comprehensive study requiring full-time services of the silviculturist in charge. Progress on the planned review of published and unpublished information on longleaf pine silviculture will be delayed during the coming year by the necessity of spending more time on other project work. Other project studies in pine silviculture, including thinning, pruning, and stand improvement studies, will be continued as far as possible with available funds and facilities.

Studies in the field of silvics will include a continuation of the work on stimulation of height growth of longleaf and the laboratory experiments on the nutritional requirements of longleaf and slash pine.

No new studies are contemplated in the field of mensuration. During 1940 a critical review of present methods of constructing volume tables is to be prepared. Because values included in the standard yield tables of loblolly pine have been questioned, a test will be made of the accuracy of the tables constructed some years ago. A report is also contemplated on the methods of inventory applicable to forest plantations.

In the field of regeneration, the long-time program of studies in the field of planting technique, seed, and nursery practice will be continued. A report is contemplated on the 15-year remeasurement of the Bogalusa spacing plantation.

In the field of forest fire protection, efforts will be continued to develop fully satisfactory fire-danger measuring devices for the southern pine types. The possibility of correlating fire-danger measurements for the whole region with the use of a single danger meter will be fully investigated. Rate-of-spread data will be analyzed for the loblolly-shortleaf-hardwood type and an attempt will be made to develop standard fire damage tables for use throughout the southern pine region.

The main emphasis in the field of naval stores will be placed on the preparation of reports of completed studies. Two new field studies are to be undertaken during 1940: (1) a further investigation of chemicals in the stimulation of gum production; and (2) a study of yields as affected by face widths on trees of varying size. Reports on chipping practice for young, vigorous slash pine stands and on the use of advanced streaks are contemplated.

FOREST-INFLUENCES

Progress has been made in the technique of watershed-improvement

In the Southern States, the problem of conserving soil and controlling run-off of rainfall on nonagricultural areas is primarily one of maintaining an adequate tree cover. This is particularly true in the extensive Coastal-Plain region, comprising the major part of the Station's territory, where soils are pervious and relatively deep and where forest cover is especially effective in maintaining soils in optimum condition for the infiltration and storage of water. Watershed-improvement studies applicable to the Coastal-Plain region and largely concentrated at Holly Springs, Miss., have demonstrated that simple reforestation measures employing chiefly native species of pine are the most effective and practical watershed-improvement techniques for the bulk of the watershed lands requiring treatment, and that mechanical measures for the control of water run-off can be limited to such simple supplementary works as check dams, soil-collecting trenches, and other structures designed to improve the growing site for vegetation.

In mountain areas, such as the Ouachita-Ozark region of Arkansas and the Appalachian Province in Alabama and Georgia, watershed-improvement techniques, although only partly investigated, apparently entail much more than reforestation measures. Here, the problem of water control is not solved by merely providing for getting the water into the soil. Although cover-improvement and restorative measures can probably be employed effectively, the control of storm run-off from many mountain areas can perhaps be best accomplished by means of upstream engineering works designed to store or temporarily retard run-off. Trials of various types of water-retardation works are now under way on the Irons Fork Experimental Forest in western Arkansas to perfect the design and observe performance of these structures in delaying or reducing flash run-off from the Ouachita Mountain streams. Among the more promising structures are diversion-spreader works of various types. These consist essentially of low dams or baffles placed across steeply pitched stream channels which divert stormflow into lateral diversion ditches and thence along the contour to locations well above the water table where the water is emptied into a series of trenches or pits, or is spread over the surface and allowed to percolate into the soil and underlying mantle rock. During the 5-inch rainstorm in April 1939, one diversion spreader diverted about 80 percent of the storm run-off from a 12-acre catchment area and safely disposed of all the run-off via underground storage without visible passage of storm run-off to stream channels downslope. The use of diversion-spreader systems on upper mountain slopes appears to be somewhat of an innovation in upstream engineering, and much experimental work remains to be done before feasibility of the method can be established.

Various types of small dams, constructed of earth, rock-fill, and other native materials and designed to store storm run-off temporarily, were further tested at Irons Fork during 1939. Complete construction records are kept, and the various structures are observed during and after each major storm in order to gage their effectiveness. Some types depend on natural seepage and evaporation to keep the reservoirs empty, while others are provided with controls to regulate outflow. The largest dam constructed to date is 7 feet high and 100 feet long, impounding more than 1-1/4 acre-feet of stormflow from a drainage area of 110 acres. Although many such storage works would be required to provide effective flood control on the lower reaches of the mountain streams, possible advantages are that they can be built quite cheaply out of native material and, being located in wild, forested terrain, will flood small reservoir areas that will receive benefit rather than damage from the temporary storage of storm run-off. In the Ouachita Mountains there appear to be a number of natural sites for small storage dams, even on the extreme upper reaches of some of the mountain streams, but special surveys and considerable additional investigation will be required to determine the specific uses of these structures.

Roadbank-stabilization methods developed

A major problem on forest-road projects in the South is the stabilization of raw, eroding backslopes. Four years of intensive investigation on this problem on the Holly Springs National Forest, Miss., have demonstrated that the establishment of a permanent grass or herbaceous cover on roadbanks affords the most satisfactory control. In the Holly Springs studies, hundreds of stabilization treatments have been tested out on a variety of soils and for a considerable range in climatic conditions. Recommendations can now be made that will be applicable to a major part of the upper Coastal-Plain region in Alabama, Mississippi, Arkansas, and Louisiana. A detailed project plan for the control of roadbank erosion on the Holly Springs National Forest was started during the year. The Holly Springs tests have fully explored the techniques of successfully establishing vegetation on roadbanks and have developed a variety of methods. The more salient findings can be summarized as follows:

Road fills: Erosion on road fills can be effectively controlled by using any of a number of methods. The use of simple brush-litter or hay mulches will usually suffice without any subsequent planting. Likewise, the sowing, sodding, or planting of most indigenous species provides effective control without necessity of using fertilizer, topsoil dressings, or other amendents.

Cutbanks (backslopes): Many grass or herbaceous species can be successfully established on relatively steep backslopes (1:1 gradient), but few will provide a permanent, self-perpetuating cover. Outstanding species for the Coastal-Plain region are Bermuda grass, Korean lespedeza, and common lespedeza. All three species can be successfully established from seed; Bermuda grass, in addition, can be established through a variety of sodding methods. In general, small pieces of Bermuda-grass sod spaced 12 inches apart provide an adequate cover. The period March to June inclusive is the optimum season for this work; in these tests fall planting gave exceedingly poor results. The best method of preparing backslopes for planting consists of light scarification followed by a uniform application of topsoil 1½-3 inches deep. Sods or seed should be placed uniformly over the treated slope instead of in pockets or contour trenches. A complete fertilizer applied at rates of 1-2 pounds per hundred square feet is recommended. No method that dispenses entirely with topsoil dressings has been developed, and the studies show that heavy fertilization or other site-improvement treatments do not satisfactorily compensate for a lack of topsoil. Organic mulches consisting of forest litter or staked weed or hay mulches are recommended on seeded slopes, but should be removed soon after growth starts, if Bermuda grass is sown. Probable maintenance needs during the second and subsequent growing seasons include: (1) light grazing or mowing to keep down weeds and native invaders, and (2) occasional applications of fertilizer.

In mountain areas such as the Ouachita region, the problem of stabilizing roadbanks is complicated by the rocky terrain, the scarcity of mineral soil, and adverse climatic factors such as frost action during the critical winter months. Furthermore, roads built in mountainous territory often necessitate large cuts and fills. To cope with these problems, mechanical controls may be required in addition to the usual cover-restorative measures. In order to develop specific measures to meet the needs of the Ouachita region, road-erosion-control problems were analyzed during the year and a working plan drafted to guide preliminary research on this particular problem.

Timber-cutting practices affect soils and ground cover

Steep mountain lands cannot be logged without causing disturbance to soils and ground cover. The extent to which timber-cutting practices contribute to storm run-off and to soil wastage can best be determined by comprehensive studies in watershed management in which precise measurements of rainfall and run-off can be made on watershed areas before and after logging. In order to explore the problem, preliminary studies were started on a 318-acre watershed at Irons Fork to obtain information on the relation of some common logging practices to water run-off and soil erosion, and to observe to what extent these practices destroy herbaceous ground cover and forest litter. The area is divided into seven tributary units, some of which were cut over selectively according to conservative Forest Service cutting practices, while others were cut clean, leaving no merchantable trees. Field surveys were made before and after logging to gage the amount of forest litter and to measure skid trails, logging roads, and other areas of disturbance. Water and soil losses are measured at the lower end of skid trails and roads as well as from comparable undisturbed areas, and future changes in ground cover will be observed on permanent sample plots distributed over the drainage units. Although a large number of trees (all those 9 inches d.b.h. and under) were left on the so-called clear-cut areas, preliminary measurements indicate that during the 9-month period subsequent to logging, skidding operations alone caused three times as much soil loss on these units as was lost from those cut over selectively. These preliminary observations are expected to shed light on those timber-cutting practices which eventually may be used as experimental treatments in watershed-management studies. In the meantime, however, they may lead to findings which would justify changes in logging practices. If skid trails and other disturbances incident to timber cutting give rise to significant soil and water losses from certain watersheds, provision for such remedies as spreading slash over bared areas, or the lateral diversion of storm run-off, can be written into timber-sale contracts or otherwise provided for.

Plans for 1940

During the coming year, the major emphasis will be on those preliminary studies at Irons Fork which will lay the groundwork for detailed problem analyses and work plans relating to long-term studies in watershed management in the Ouachita-Ozark Mountain region. Among these are preliminary investigations of rainfall-run-off relations and observations on the effects of timber-cutting practices on watershed values. Of the more urgent short-term investigations, main consideration will be given to further trials of various upstream water-retarding works applicable to the mountain section of Arkansas and Oklahoma. As a relatively minor investigation, further tests of soil-collecting trenches and other simple watershed-improvement techniques applicable to the Coastal-Plain region will be made at Holly Springs.

Roadbank-stabilization problems of the Ouachita Mountain region will be actively investigated. Results from the Holly Springs studies will be reported in suitable form for use on road projects of the Forest Service and other road-building agencies. Such additional field trials as may be necessary will be put in with a view to exploring a few remaining problems and to serve as demonstrations.

If resources permit, a problem analysis will be made of watershed-management problems in the upper Coastal Plain in order to determine the need and justification for comprehensive studies on the relation of forest-management practices to streamflow and water supply in this important region.

FLOOD CONTROL SURVEYS

Flood-control survey findings contribute to better management of forest lands

Flood-control surveys of the Department of Agriculture, in which the Station is participating (in cooperation with the Soil Conservation Service and the Bureau of Agricultural Economics), are mainly concerned with the formulation of programs of waterflow retardation and soil-erosion prevention for the alleviation of flood damage. They entail an inventory of all land-use practices that relate to water use and control, an appraisal of the extent to which each measure can reduce or prevent flood damage, and finally, the formulation of a specific remedial program the cost of which must not exceed anticipated benefits. The findings from a survey therefore provide a framework or plan for desirable land-use practices and adjustments that is definitely oriented toward flood control, but relates in some measure to most aspects of land use.

Regardless of whether survey findings lead eventually to a specific flood-corrective program, they provide highly useful information for the Forest Service or other action agencies charged with the administration and management of publicly owned lands. For example, a flood-control survey must delineate those watershed areas which are contributing excessive run-off or injurious sediments to streams. These source areas may consist of publicly owned lands on which watershed cover has deteriorated as a result of other uses, or they may consist of low-value, abandoned lands in private ownership that can best be managed for maximum watershed protection under Federal or State sponsorship. This information is highly usable in connection with land acquisition programs of State and Federal agencies, especially since it includes data as to present use and condition of all classes of land within the watershed. Furthermore, the value of such data is enhanced by supporting information as regards the economic potentialities of the lands in question and by special analyses of social aspects which must be considered in all land-acquisition programs. The inventory phases of a flood-control survey, although only incidental to the main job, supply types of basic data of real worth in many fields of land-use or resource planning.

Perhaps a major contribution from flood-control surveys is an evaluation of various watershed-improvement practices in terms of the financial value of their benefits to flood control, soil and water conservation, reduction in sedimentation damage, etc. There are many practical uses for information of this kind. For example, in connection with fire-protection programs on the national forests or those undertaken under the provisions of the Clarke-McNary Act, the appraisal of fire damages or establishment of the need for protection programs in a given area requires evaluations difficult at present for lack of much factual basis. Flood-survey requirements are such that flood-control and other subsidiary benefits resulting from fire protection must be adequately determined, inasmuch as fire control provides one of the most potent means of reducing storm run-off in many watersheds. Similar contributions are made with respect to reforestation programs in the South, where extensive areas are now being planted to trees, mainly with a view to perpetuating a timber supply. The majority of these plantings may confer subsidiary benefits in that they conserve soil, reduce storm run-off, etc. Data from the flood surveys will indicate the extent to which reforestation measures reduce or alleviate floods, and hence will serve to clarify objectives and policies governing forestry measures of this type.

Plans for 1940

During the coming year the Station will assist in completing and carrying on detailed surveys in the following watersheds: Trinity, North and South Concho, and middle Colorado rivers in Texas; Neosho-Grand in Kansas, Oklahoma, Arkansas and Missouri; White in Arkansas and Missouri; Lower Arkansas in Arkansas; and Little Tallahatchie and Yazoo in Mississippi. In addition, preliminary examinations of several watersheds will be undertaken.

FOREST ECONOMICS

FOREST TAXATION

Forest taxation—necessary but troublesome

The certainty of taxes, like that of death, is recognized by all owners of forest land. What they want to know, however, is how much the forest taxes are now; what they may expect such taxes to be in the future; whether these taxes will take so much of present or prospective income from the property as to render its continued ownership financially unwise or impossible; what the relation is between their annual tax bill and the kind, condition, and volume of the timber and timber land they own; and the nature of, and prospects for, tax reform if it is needed.

On the other hand, it is recognized by tax officials that the "high taxes" complaint is all too frequently used as an excuse for liquidation of timber holdings by owners whose "cut out and get out" policy is really based upon other reasons. Conversely, as a counter-attack, the policy of "get while the getting is good" is adopted by county authorities to salvage while they may. Such attack and counter-charge frequently end in widespread tax delinquency.

These questions and their answers are those which the Southern Station, in its forest taxation studies, has explored and will continue to explore in order to provide all present and prospective forest owners not only with current and factual data on forest taxation and tax-delinquency, but with recommendations for the improvement of the situation.

Taxation findings being used by public agencies and private taxpayers

The information obtained in past years has already been widely used by taxpayers and by public officials in answering specific problems of forest management, land ownership possibilities, tax reform, and tax delinquency causes, effects, and remedies. In Arkansas and Mississippi, improvements in tax legislation have been made, based to a large extent on the findings of this Station. In other States, revisions have been suggested after careful study but have not yet been enacted into law. Nevertheless, so detailed are the problems of proper tax administration, so slow the process of sound and permanently desirable tax reform, so large and complex is the forest area of the Lower South, that so far the surface has been merely scratched in investigation and study in this field.

Current trends in forest taxes—a new study

In order to build up the basic data necessary to answer more accurately and currently the questions raised in the first paragraph of this statement on forest taxation, a long-time study was initiated in 1939, specifically to obtain data on the trends, over a period of years, in the average tax per acre on forest land bearing various kinds and conditions of timber, or clear-cut. This study is designed to obtain these data in representative counties in each major forest region in each State of the Lower South. Forest properties are classified by forest type and condition-class and the average ad valorem taxes per acre are computed for each class of each type in each study-county. These data, when accumulated for a series of years, will provide a picture, not only of current taxes for any given year, but of trends and history of past taxation for each region and for given types and condition-classes, on which reasonably accurate forecasts of future tax trends can be based. Already frequent requests for such information have been received, and as recognition of the significant and highly important place of forests and forestry in the South's economy continues to grow, these demands will inevitably increase. To date, four counties in Mississippi have been covered (Marion, Newton, Alcorn, Quitman) and the data compiled and partly analyzed for the taxes of 1936, 1937, 1938, and 1939.

The job ahead and plans to meet it

During 1940, the major effort will be to expand the coverage of the study of current trends in forest taxes. Additional territory will be included in the investigation as far and as rapidly as available facilities permit. Obviously, these data, to be of value, must be kept current by obtaining them in the same counties annually or at least biennially. Equally obvious is the necessity of extending the study to other States, to provide, ultimately, a picture of current forest taxation trends throughout the Lower South.

FINANCIAL ASPECTS OF PRIVATE FORESTRY

The practice of forestry on private lands is increasing

During 1939 private forestry in the Lower South showed progress. The paper industry continued to expand, many companies purchasing large blocks of timber to assure a backlog of raw material for their operations. The lumber industry enjoyed one of its best years since the depression. Other forest industries were also very active. With keen competition for timber and with widespread markets for pulpwood, ties, poles, and sawlogs, both large owners and farmers are rapidly becoming conscious of the potential value of forest land for producing timber crops profitably. Forest land owners are becoming more receptive to suggestions for adopting good forestry practices, and many large land owners and farmers have actually adopted practices which will give them a continuous yield of forest products.

A paucity of management data

Statistics on results of continuous management of forests over a long period of years are not available in the South, and there are many unanswered questions concerning methods of cutting, allowable cuts and optimum amounts of growing stock, logging methods, and costs and returns. Forest management, to be successful, must not only produce continuous yields of merchantable forest products but must also produce them with a reasonable margin of returns over costs. The purpose of the Station's private forestry investigations is to determine the most profitable methods of managing and utilizing private forests. Studies to date have been limited largely to the shortleaf-loblolly pine type.

The Crossett Experimental Forest serves many forest owners

The Station maintains the Crossett Experimental Forest [illegible] southeastern Arkansas to study and demonstrate different methods of management in the prevailing loblolly-shortleaf-hardwood type. Here the costs and returns of integrating the growing and utilization of sawlogs with that of pulpwood, posts, and chemical wood are being studied. Pilot studies on 26 separate 40-acre management units on the Experimental Forest, made in typical second-growth shortleaf and loblolly pine under economic conditions similar to those of commercial operations, are determining facts essential to private owners such as: (1) relative returns from harvesting trees for sawlogs, pulpwood, posts, and other products, singly or in combination, and the size and age at which trees become financially mature for these various products; (2) costs and best methods of logging; (3) optimum amount of growing stock for greatest yields of most valuable products; (4) length of cutting cycle to obtain the most rapid growth and the largest net returns; and (5) costs and returns from improvement cuttings, thinnings, and selective timber management. The results obtained from these small-scale studies are being applied on a commercial basis by the Crossett Lumber Company and by other companies, both large and small.

The Crossett Experimental Forest was visited and its records studied during 1939 by several hundred farmers, lumbermen, pulpwood operators, other timberland owners, and foresters. They came from many States of the Union and even from foreign countries.

Plans for 1940

During 1940, operations on the Crossett Experimental Forest will be continued according to the cutting budget, and records of growing stock, yields, incomes, and costs will be added currently to the ledger. Of special interest will be the records of growth, allowable cut, income, and costs from those 40-acre tracts that are scheduled for a second cut in 1940 at the end of the first 3-year cutting cycle. A similar study will be made also in virgin, second-growth, and old-field stands that were cut in 1935 on Company lands. These will be among the first measurements to be made of the results of selective timber management in the South. Based on these and other available data bearing upon the financial aspects of private forestry, estimates of the financial results to be expected from the application of forest management to typical properties in the shortleaf and loblolly pine region will be released.

FOREST SURVEY

Need for the Survey

The solution of many of the South's most pressing economic problems is, in a large sense, tied up with making the most of her forest lands, and for this reason forest research has a very significant part to play. Forestry policies, both regional and local, must be based on knowledge of this resource. We must know its volume, what it is composed of, its capacity for continued production, its present use, and how it can best meet future requirements. Sound management policies must be based upon an understanding of the natural laws and principles underlying the development and use of the resource. The basis for both action and research programs is a forest inventory.

The job and the progress made

The Forest Survey, for which active field work was started in 1931, has covered over 215 million acres in the Lower South. This area was divided into units of from 4 to 10 million acres, and up to the present time over 50 releases and unit reports have been issued, covering in detail almost 200 million acres of this area. These reports show the area and volume of forests, their character and use, and timber growth and drain; they also outline suggested improvements.

Survey findings are already affecting Southern industrial development

Much use has been made of these reports. There has been a tremendous demand for this information, not only local, but Nation-wide. Survey findings have played a large part in locating pulp mills in the South through their resource information for specific regions. All but a few of the 12 new pulp mills located in the Lower South have used Forest Survey data as a basis for preliminary investigations, and several of them have used Survey Reports as supporting data in application for loans. Survey data have been used in equal degree in the early stages of fixing the naval stores policy of the AAA program. They have been used by a large number of industrial organizations in calculating the prospective timber supply, such as for veneer, cedar posts, shuttle blocks, cross ties, poles, etc.; by cities and ports in seeking industrial expansion; by sawmills seeking new supplies of certain species; by railroads seeking development of new sources of freight along their lines; and by financial houses seeking information as a basis for construction loans for pulp mills or sawmills, and other investments.

Essential in public agency planning

In addition to this, Forest Survey data have been used as the authoritative basis in every State and regional land-use and industrial development plan prepared by the planning boards under the general sponsorship of the National Resources Committee. The data have gone into the development plans of the T.V.A. They have been used in fixing Federal allotments to States under the fire protection sections of the Clarke-McNary Act. They have gone into the basis for forest tax legislation in several States, and they have been used over and over again by State forest service organizations. Regional Offices of the U. S. Forest Service have used the data as a base for acquisition plans, and in reports for sustained-yield sub-units in or adjoining the national forests.

An aid in forestry extension activities

An important effect of the whole Forest Survey project has been to give, for the first time, a widespread understanding of the need for forestry and what good forestry can do for the South. It has greatly aided the effort of foresters to establish in the minds of industrialists, economists, statesmen, publicists, and the people an appreciation of the fact that the timber resources can be perpetuated, increased in extent and value, and made a potent instrument in the continued economic growth of the South. It has served in so doing to give, for perhaps the first time, a sound and acceptable reason for expenditures of large sums of public and private moneys in fire protection, stand improvement, and market development, and has stimulated greatly the interest of landowners in sustained timber crop production.

A sound basis for research programs

Forest Survey data have also clarified and pointed up the research problems of the Southern Forest Experiment Station. They have made obvious, more than ever before, the lines of endeavor needing study and research, and have given a better concept of priorities. At the same time, the findings of the Survey have furnished additional justification for an extension and intensification of research efforts called for by the magnitude of the task.

The Survey data already growing cold

As in all business, an inventory is good only at the time it is taken. Using Survey growth calculations and drain statistics compiled from the Census and special studies, it has been, and will be, possible to keep reasonably up to date for a few years, but it is quite obvious, with the fast-moving developments now taking place in the South, that the reliability of the data decreases each year. Already, despite all our efforts, in certain parts of the South the inventory is out of date. Certain sections—southern Arkansas, and the naval stores region of southern Georgia and northeastern Florida, for instance—have made great advances in fire protection, and a change has taken place in the tree mortality rate. On the other hand, stepped-up industrialization may have materially changed the volume and character of drain.

New inventories needed

New inventories are needed in such regions, though present plans contemplate mainly the preparation of an over-all report on the Lower South. Conditions in the Southeast justify a new survey in 1942 to see how the timber budget stands. The welfare of the communities and industries involved will depend upon keeping a close tab on the inventory, growth, and drain situation in order that the forest resource may have the fullest possible use without violating the principle of sustained wood supply.

COOPERATING AGENCIES

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Progress of research on forest insects in 1939

An epidemic of several species of Ips and the southern pine beetle, on 6,000 acres of privately-owned lands in southeastern Jasper County, Texas, was controlled early in August 1939 after 24 million board feet of mature loblolly pine had been killed, of which 16 million board feet was salvaged. Lack of rainfall during the growing season, in some instances, complicated by fire scorching the trunks, led to killing of the tops of the weakened trees by Ips and a later epidemic of southern pine beetles.

Control consisted in selective logging of the infested and susceptible trees within a quarter-mile radius of active centers of infestation; at the height of operations in June and July, 70 trucks hauled 300,000 feet of timber per day to three mills within a 25-mile radius of the infested area. While isolated summer cuttings may induce insect attacks, it has been found that selective cuttings can progress over large forests in summer without leading to epidemics of bark beetles.

Silvicultural and chemical experiments are in progress on the Kisatchie National Forest for control of the pine tip moth which is troublesome in pure stands of pine seedlings whether natural or planted.

In controlling leaf-cutting ants the accepted procedure consists of pouring carbon bisulphide into the ants' nests prior to forest planting. A series of new chemicals are being tested in efforts to discover safer fumigants.

Root injuries to forest nursery stock are often caused by white grubs, Phyllophaga. A census of these insects has revealed the presence of 59 species. An outbreak of white grubs in a nursery at Olustee, Fla., was successfully checked by using carbon bisulphide.

The problem of insect attacks on forest products is also being investigated. Several chemical sprays appear to protect green lumber from attack by ambrosia beetles for a reasonable time, but another year's experience is necessary to determine this conclusively. These beetles can be prevented from attacking green lumber by end-racking it for as long as 15 days, when the moisture content will be reduced to 45-52 percent, too low for the beetles. Both the biology of ambrosia beetles and the fungi which they cultivate are being studied.

Another season's experience will be necessary to determine whether chemical dips can be commercially used for the prevention of attack by Lyctus powder-post beetles. Lumber containing as high as 25 percent moisture may be attacked by these beetles. The length of the life cycle may be as short as three months, but this period depends on the starch content, the time required for seasoning of the lumber, and on temperature. With a constant-temperature chamber, it is now possible to carry on tests throughout the year.

Inadequate protection of buildings against termites is very common in the South. Efficient shields to prevent attack can now be installed in foundations at a cost of not more than 20 cents per linear foot. For preventing termite damage to buildings the Home Owners' Loan Corporation, in their master specifications of June 1939, accepted this Bureau's specifications. New standard soil-poison tests for termite control have been started on the Harrison Experimental Forest. A cooperative study is being made of the use of chemicals in fiberboards to prevent attack by termites.

BUREAU OF PLANT INDUSTRY

Progress in forest pathology in 1939

Relatively new in the South is the "little-leaf disease," affecting shortleaf and loblolly pines, and now the subject of study, to reveal its cause and distribution. Over an area extending from the Piedmont section of South Carolina to western Alabama, many of these pines (4 inches d.b.h. and larger) were found dying from some obscure cause. Symptoms of the trouble as noted on individual trees include premature loss of part of the foliage and death of branches starting with those closest to the ground. In the later stages the foliage on a tree is greenish yellow, reduced in length, and limited to needles of the current growing season.

The progress of the disease in a stand of timber is characteristically irregular and unlike that due to other tree-destroying agencies. Affected trees here and there drop out of the stand as individuals, and trees in all stages of the disease may be found among those that are apparently healthy. In the most severely affected stands, where trees have been dying for the last 4 to 8 years, timber values have been sharply reduced.

In order to prevent or minimize nursery infections with the native canker-forming rusts, Cronartium fusiforme, and C. cerebrum, an oak-free barrier 1500 feet wide around one forest nursery is under test. So far, however, late sowing, together with early and thorough spraying of young seedlings, shows promise as a practical means of control. The folly of planting cankered seedlings is manifested the first year by excessive mortality.

In causing damage to forest products certain wood-staining fungi and ambrosia beetles are associated. Cultivated by the beetles apparently for use as food, most of these fungi cause a black stain. Furthermore, important general staining fungi were isolated from 17 percent of 183 adult beetles examined. Besides ambrosia beetles, the pine bark beetles (Ips, Orthotomicus, and probably at times Dendroctonus) were found to be agents for stain dissemination to a degree serious enough to justify their control solely for stain prevention. Field observations indicate that the usual weathered wood debris in mill yards has little influence on the amount of stain present, but that fresh green slabs, edgings, etc., accumulating around a mill are probably important sources of stain inoculum.

Longleaf depredation by birds

On the Harrison Experimental Forest in southern Mississippi birds have been largely responsible for the destruction each fall and early winter of longleaf pine seed and seedlings. Birds previously reported as raiders of pine seed are now being reinforced by an alien newcomer in the cut-over lands.

The European starling, Sturnus vulgaris, is spreading rapidly and threatens to become extremely destructive to longleaf pine reproduction. It was only a year ago that the first small flocks were observed, associated with red-winged blackbirds and cowbirds, and feeding with them in the open pine woods. The preference of these starlings for pine seeds is indicated by analysis of their stomach contents. Should the enormous flocks now found further north during the winter months ultimately invade the Gulf States, the damage to longleaf pine reproduction will become acute.

The possibility of limiting damage by seasonal control of direct seeding was investigated again this year in southern Mississippi. At intervals of two weeks from late October until late December broadcast sowings were made on rough and burned surfaces. As in other years of abundant seed supply, however, the number of birds was correspondingly large, and they succeeded in consuming most of the seeds regardless of the nature of the surface on which they were sown.

Plans for 1940

Investigations of forest insects of economic importance to forestry practice will be continued by the Bureau of Entomology and Plant Quarantine. Studies are contemplated on the problem of insects injurious to trees, plantations, and nurseries, as well as those affecting manufactured forest products.

In the field of forest pathology, the Bureau of Plant Industry will continue investigations of canker-forming rusts and of stain-producing fungi. Studies of the little-leaf disease of shortleaf pine will be continued. Investigations of the brown-spot needle blight were practically completed in 1939 and no further large-scale investigations are contemplated.

In the field of forest biology, the Biological Survey will continue studies of bird and rodent damage to longleaf pine reproduction through the extension of the work to Georgia and Florida.

PERSONNEL

SOUTHERN FOREST EXPERIMENT STATION

Jan. 1, 1939 - Dec. 31, 1939

ADMINISTRATION

E. L. Demmon	Director
Oran L. Raber	Conservationist
John A. Lubbe	Jr. Adminis. Officer
Vera S. Lind	Sr. Clerk
Agnes G. Terburg	Sr. Clerk-Stenog.
H. C. Bradshaw (trans. to California For. & Range Exp. Sta. 8/16/39)	Clerk
Marie M. Flad	Clerk-Stenog.
Charles H. Langhoff, Jr	Asst. Stat. Clerk
John E. Lau	Asst. Clerk-Stenog.
Helen Schweitzer	Asst. Clerk-Stenog.
Norma Wooddy (trans. from R.8, 3/1/39)	Sr. Stenog.
Ventura J. Houpy	Jr. Multilith Opr.
Lillian E. Roane	Jr. Clerk
Iretta C. Austin	Telephone Operator

FOREST MANAGEMENT

John R. Curry (trans. from California For. & Range Exp. Sta. 7/1/39)	Prin. Silviculturist
Henry Bull	Silviculturist
Philip C. Wakeley	Silviculturist
W. G. Wahlenberg	Forester
C. Allen Bickford	Assoc. Silviculturist
Roy A. Chapman	Assoc. Silviculturist
Eugene W. Gemmer	Assoc. Silviculturist
Theodore A. Liefeld	Assoc. Silviculturist
Louis J. Pessin	Assoc. For. Ecologist
David Bruce (E.O.D. 7/24/39)	Jr. Forester
Herbert H. Muntz (assigned from Region 8)	Jr. Forester (CCC)
*Mary L. Nelson	Jr. Plant Physiol. (CCC)
Arthur L. Shepard	Asst. to Tech.
*Thomas A. Hudgens (S.S.T. 8/24/39)	Asst. to Tech. (CCC)
*Richard C. Smith	Asst. to Tech. (CCC)
*Archie E. Patterson (S.S.T. 6/17/39)	Asst. Field Asst. (CCC)
*Tommy T. Kohara (E.O.D. 7/13/39)	Under Field Asst.
*William M. Palmer (trans. to N.E.F.E. 6/19/39)	Under Field Asst.
Robert L. Brooks	Minor Asst. to Tech. (CCC)
Carl W. Cox (trans. to Appalachian For. Exp. Sta. 9/1/39)	Minor Asst. to Tech. (CCC)
Charles D. DeShazor	Minor Asst. to Tech. (CCC)
Henry W. Hughes	Minor Asst. to Tech. (CCC)
Jack B. Pearson	Minor Asst. to Tech. (CCC)
Norman M. Scarbrough	Minor Asst. to Tech. (CCC)
Ashley G. Williams	Minor Asst. to Tech. (CCC)

FOREST MANAGEMENT (Cont.)

Elizabeth Bergland	Clerk Stenog.
Clark H. Streetman	Clerk
Mary R. Craig	Asst. Clerk
William G. O'Regan	Asst. Stat. Clerk

FOREST SURVEY

I. F. Eldredge	Prin. For. Econ.
Frank A. Ineson	Sr. For. Econ.
Arthur R. Spillers (trans. to R.7, 8/16/39)	Forester
R. K. Winters (trans. to Northern Rocky Mt. For. & Range Exp. Sta. 7/1/39)	Forester
Philip R. Wheeler	For. Econ.
James W. Cruikshank (trans. to Appalachian For. Exp. Sta. 7/1/39)	Assoc. For. Econ.
Virgil B. Davis	Assoc. For. Econ.
Harry F. Smith	Asst. For. Econ.
William S. Stover	Asst. For. Econ.
George B. Ward, Jr.	Jr. Forester
Robert D. Andrews	Eng. Draftsman, Civil
Camelia M. Larsen	Clerk
Martha E. Nelson	Clerk
Lucille P. Olsen (resigned 2/11/39)	Clerk
Elsa M. Rayl (trans. to B.A.E. 12/1/39)	Clerk
Elmire A. Even (LWOP 8/24 - 12/31/39)	Asst. Stat. Clerk
M. Madeleine Archinard	Asst. Clerk-Stenog.
Earline C. Taylor (E.O.D. 9/21/39)	Jr. Clerk-Stenog.
Honora W. Cassens (furlough 2/1 - 4/30/39)	Jr. Tab. Mach. Opr.

FOREST ECONOMICS

I. F. Eldredge	Prin. For. Econ.
W. E. Bond	Sr. For. Econ.
R. R. Reynolds	For. Econ.
Ronald B. Craig	Assoc. For. Econ.
Ike W. Rawls	Asst. to Tech.
E. Holger Wahlsteen (trans. from Appalachian For. Exp. Sta. 12/16/39)	Field Asst.
Bertha H. Schneider (LWOP 9/21 - 12/31/39)	Jr. Clerk-Stenog.
G. W. Turner, Jr. (E.O.D. 1/3/39	Jr. Clerk-Stenog.

FOREST INFLUENCES

H. G. Meginnis	Sr. Silviculturist
Norman E. Hawes (trans. from Appalachian For. Exp. Sta. 6/1/39)	Assoc. Forester
M. H. Collet (trans. to Rocky Mt. For. & Range Exp. Sta. 6/1/39)	Asst. Forester
*Ronald A. Hickey	Jr. Eng. Aide (CCC)
*Edwin R. Ferguson	Jr. Field Asst. (CCC)

FOREST INFLUENCES (Cont.)

John L. Gammage	Minor Asst. to Tech. (CCC)
Hubert W. Gray	Minor Asst. to Tech. (CCC)
Harold R. Johnson	Minor Asst. to Tech. (CCC)
*Charles C. Lynn	Under Asst. to Tech. (CCC)
Ruth Marshall	Asst. Clerk-Stenog.

FLOOD CONTROL SURVEYS

H. G. Meginnis	Sr. Silviculturist
M. M. Lehrbas	Silviculturist
Douglas Basnett (trans. from Mississippi N. F. 12/16/39)	Forester
Lewis M. Turner	Forester
William A. Kelly (detailed from Central States For. Exp. Sta. 9/1/39)	Sr. Hyd. Eng.
Harry M. Cortright	Assoc. Hyd. Eng.
James H. Foster (detailed from Central States For. Exp. Sta. 11/16/39)	Assoc. Hyd. Eng.
Elon H. Bomberger	Assoc. Forester
Edsko J. Dyksterhuis	Assoc. Range Exam.
Carl F. Olsen	Assoc. Silviculturist
Martin E. Baudendistel	Asst. Forester
Walton R. Smith	Asst. Forester
Albert K. Thurmond, Jr. (trans. from Caribbean N. F. 12/16/39)	Asst. Forester
John L. Arend (trans. from Central States For. Exp. Sta. 11/23/39)	Jr. Forester
Lowell F. Baker	Jr. Forester
John F. Kellogg (trans. from Kisatchie N. F. 1/16/39)	Jr. Forester
John J. Kerst	Jr. Forester
Lee S. Settel (trans. from Ouachita N. F. 12/16/39)	Jr. Forester
Glenn A. Spears (detailed from Central States For. Exp. Sta. 11/16/39)	Jr. Forester
Truman E. Pease	Sr. Forest Ranger
Harold C. Kaelin (detailed from Central States For. Exp. Sta. 12/16/39)	Eng. Draftsman
Lester E. Carstens	Asst. Eng. Draftsman
Herbert L. Daniels	Asst. Clerk
Isabell L. Nelson	Jr. Clerk-Stenog.
Allen M. Byrd	Jr. Cal. Mach. Opr.

Staff of Cooperating Federal Bureaus

BUREAU OF PLANT INDUSTRY

P. V. Siggers	Assoc. Pathologist
A. V. Verrall	Asst. Pathologist
Bailey Sleeth	Asst. Pathologist
Howard Lamb	Asst. Conservationist

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

T. E. Snyder	Sr. Entomologist
H. R. Johnston	Jr. Entomologist
Ruth E. Wood	Asst. Clerk-Stenog.

BUREAU OF BIOLOGICAL SURVEY

Thomas D. Burleigh	Assoc. Biologist

*Informal appointments

PUBLICATIONS

Jan. 1, 1939 - Dec. 31, 1939

Bickford, C. A., and Bruce, David - A tentative fire-danger meter for the longleaf-slash pine type. Occasional Paper No. 87. Southern Forest Expt. Sta. 6 pp., illus. Nov. 10, 1939.

———— and Bruce, David - Fire-discovery time in the longleaf-slash pine type. Occasional Paper No. 88. Southern Forest Expt. Sta. 5 pp., illus. Dec. 27, 1939.

Bond, W. E. - Costs and returns of managing 100,000 acres of shortleaf and loblolly pine for sustained yield. Occasional Paper No. 79. Southern Forest Expt. Sta. 15 pp. Jan. 9, 1939.

Bull, Henry - The relation of forest research to the farm chemurgic movement in Arkansas. (Address delivered before Second Chemurgic Conference of The Arkansas Council of Agriculture, Science and Industry, May 2 - 3, 1939, Little Rock, Arkansas.) Proceedings of the Second Chemurgic Conference of the Arkansas Council of Agriculture, Science and Industry, May 2 -3, 1939, Little Rock, Arkansas. 23-29 pp.

———— - Loblolly pine vs. cotton: A comparison of annual cellulose production per acre. Jour. Forestry 37 (7): 570-571. July 1939.

———— - Increased growth of loblolly pine as a result of cutting and girdling large hardwoods. Jour. Forestry 37 (8): 642-645. Aug. 1939.

———— - Comparative cellulose production from loblolly pine and from cotton. Southern Pine Forestry Notes No. 60. Southern Pine Assn. Sept. 1939.

———— - Speaking of cellulose. American Cotton Grower 5 (7): 13, illus. Dec. 1939.

Burleigh, Thos. D. - Alta Mira Oriole in Texas - An addition to the A. O. U. Check List. The Auk 56 (1): 87-88. Jan. 1939.

———— and Sutton, George Miksch - A list of birds observed on the 1938 Semple Expedition to northeastern Mexico. Occasional Papers of the Museum of Zoology. No. 3. La. State University. 46 pp. April 5, 1939.

Burleigh, Thos. D. - Notes on a recent field trip to southern Florida. The Fla. Naturalist 12 (4): 95-96. July 1939.

______ and Lowery, George H., Jr. - Description of two new birds from western Texas. Occasional Papers of the Museum of Zoology. No. 6. La. State University, pp. 67-68. Nov. 10, 1939.

______ and Sutton, George Miksch - A new blue bunting from Tamaulipas. The Auk 56 (1): 71-72. Jan. 1939.

______ and Sutton, George Miksch - A new screech owl from Nueve Leon. The Auk 56 (2): 174-175. April 1939.

______ and Sutton, George Miksch - A new Abeille's grosbeak from Tamaulipas. Proceedings of the Biological Society of Washington, Vol. 52, pp. 145-146. Oct. 11, 1939.

Chapman, R. A. - A method for inventorying planting stock in forest nurseries. Occasional Paper No. 86. Southern Forest Expt. Sta. 10 pp. Oct. 12, 1939.

Christian, M. B. - Chemical dips tests against Lyctus Powder-Post Beetles. Southern Lumberman 159 (2009): 105-109, illus. Dec. 15, 1939.

______ - Experiments on the prevention of Ambrosia Beetle damage in hardwoods. Southern Lumberman 159 (2009): 110-112, illus. Dec. 15, 1939.

Collet, M. H. - Pole-type stock barrier. Construction Hints 5 (2): 4-5, illus. Feb. 1939.

______ - The slope scale. Jour. Forestry 37 (7): 580-581, illus. July 1939.

Craig, Ronald B. - The extent of long-term tax delinquency in certain Oklahoma counties. Occasional Paper No. 80. Southern Forest Expt. Sta. 43 pp. Feb. 18, 1939.

______ - The forest tax delinquency problem in the South. Southern Economic Journal 6 (2): 145-164. Oct. 1939

Cruikshank, James W. - Forest resources of southwest Louisiana. Forest Survey Release No. 43. Southern Forest Expt. Sta. 38 pp., illus. April 6, 1939.

______ and Eldredge, I. F. - Forest resources of southeastern Texas. U. S. Dept. Agr. Misc. Pub. No. 326. 37 pp., illus. Feb. 1939.

Demmon, E. L. - Research results in southern forestry. Southern Conservationist and American Tung Oil 6 (4): 11, 15-17. July 1939.

______________ - Relationship between forests and water in Mississippi. The Conservationist 6 (8): 15. Dec. 1939.

______________ - Forest research in the South. Slash Pine Cache. Vol. 2, pp. 15-16. 1939.

Eldredge, I. F. - What are we going to do with our hardwoods? (Address delivered before the Southern Paper Festival Assn., Savannah, Ga., April 17-19, 1939.) Occasional Paper No. 82. Southern Forest Expt. Sta. 9 pp. May 16, 1939. Southern Power and Industry 57 (6): 76-79. June 1939.

______________ - Forests in the economy of the South. Occasional Paper No. 83. Southern Forest Expt. Sta. 6 pp. May 20, 1939. Southern Conservationist and American Tung Oil 6 (4): 13-14, 17. July 1939.

______________ - The new forests of the Old South. Southern Lumberman 159 (2009): 99-104. Dec. 15, 1939.

Heyward, Frank - The relation of fire to stand composition of longleaf pine forests. Ecology 20 (2): 287-304, illus. April 1939.

______________ - Some moisture relationships of soils from burned and unburned longleaf pine forests. Soil Science 47 (4): 313-327, illus. April 1939.

Hunt, George M., and Snyder, T. E. - An international termite exposure test. Tenth Progress report, 35th annual meeting of American Wood-Preservers' Assn. Jan. 24-26, 1939. 12 pp.

Ineson, F. A. - Forestry as it is related to the Long-Term Agricultural-Credit Program. (Address delivered before the 1939 Conference National Farm Loan Assn. Boards of Directors' Representatives and Sect'y - Treas. in New Orleans, La., Aug. 22, 1939.) Southern Conservationist 6 (6): 16-17. Sept. 1939.

Liefeld, T. A. - How long will a streak yield gum? Naval Stores Review 48 (50): 10, 14. March 11, 1939.

______________ - The effect of season on streak behavior. Naval Stores Review 49 (3): 14. April 15, 1939.

Liefeld, T. A.	- Marking and numbering trees with paint in stick form. Jour. Forestry 37 (7): 584-585, illus. July 1939.
______________	- A simple, efficient sign-stenciling apparatus. Jour. Forestry 37 (12): 971-972, illus. Dec. 1939.
Meginnis, H. G.	- Soil-collecting trenches as substitutes for temporary check dams in reforesting gullies. Jour. Forestry 37 (10): 764-769, illus. Oct. 1939.
Osborne, J. G.	- A design for experiments in thinning forest stands. Jour. Forestry 37 (4): 296-304, illus. April 1939.
Pessin, L. J.	- Root habits of longleaf pine and associated species. Ecology 20 (1): 47-57, illus. Jan. 1939.
______________	- Density of stocking and character of ground cover as factors in longleaf pine reproduction. Jour. Forestry 37 (3): 255-285, illus. March 1939.
______________	- Tree dwellers. American Forests 45 (9): 456-457, 469, illus. Sept. 1939.
Raber, Oran	- Bioclimatics - The what and why. (Review of: Bioclimatics - A science of life and climate relations. By Andrew Delmar Hopkins. U. S. Dept. Agr. Misc. Pub. No. 280.) Ecology 20 (3): 413-416. July 1939.
______________	- Compound words. Science 90 (2329): 157. Aug. 1939.
______________	- German-English Dictionary for Foresters. U. S. Dept. Agr., Forest Service, 1939. 346 pp.
Reynolds, R. R.	- Small trees yield meager profit. American Lumberman 3143: 35. Jan. 14, 1939.
______________	- Possible returns from planted loblolly pine. Jour. Forestry 37 (3): 250-255. March 1939.
______________	- Trailer loading system reduces cost of truck logging operation. Southern Lumber Journal 43 (3): 68-69, illus. March 10, 1939.
______________	- Improvement cuttings in shortleaf and loblolly pine. Occasional Paper No. 81. Southern Forest Expt. Sta. 4 pp. March 7, 1939. Jour. Forestry 37 (7): 568-569. July 1939.
______________	- Truck logging with detachable trailers. Southern Lumberman 159 (1999): 51-53, illus. July 15, 1939. Occasional Paper No. 85. Southern Forest Expt. Sta. 5 pp., illus. Aug. 9, 1939.

Reynolds, R. R. - Management of the forest for maximum production. Michigan Forester. Vol. 20, pp. 12-15, 63. 1939.

Siggers, Paul V. - Scirrhia acicola (Dearn.) n. comb., the perfect stage of the fungus causing the brown-spot needle blight of pines. Phytopathology 29 (12): 1076-1077. Dec. 1939.

Smith, M. R. - The Texas leaf-cutting ant (Atta Texana Buckley) and its control in the Kisatchie National Forest of La. Occasional Paper No. 84. Southern Forest Expt. Sta. 11 pp. May 25, 1939.

Southern Forest Experiment Station - The Harrison Experiment Forest. 4 pp. Sept. 1939.

__________ - Southern Forestry Notes No. 25. Jan. 1939.

__________ - Southern Forestry Notes No. 26. March 1939.

__________ - Southern Forestry Notes No. 27. May 1939.

__________ - Southern Forestry Notes No. 28. July 1939.

__________ - Southern Forestry Notes No. 29. Sept. 1939.

__________ - Southern Forestry Notes No. 30. Nov. 1939.

Spillers, A. R. - Forest resources of central Georgia. Forest Survey Release No. 41. Southern Forest Expt. Sta. 29 pp. Jan. 31, 1939.

__________ - Forest resources of north central Georgia. Forest Survey Release No. 44. Southern Forest Expt. Sta. 28 pp. June 15, 1939.

__________ - Forest resources of north Georgia. Forest Survey Release No. 45. Southern Forest Expt. Sta. 29 pp. June 30, 1939.

__________ - Forest resources of southeast Alabama. Forest Survey Release No. 47. Southern Forest Expt. Sta. 32 pp. Dec. 8, 1939.

Stover, W. S. - Our southern forests. Southern Pulp and Paper Journal 2 (6): 19-23. Nov. 1939.

Verrall, A. F. - Relative importance and seasonal prevalence of wood-staining fungi in the southern states. Phytopathology 29 (12): 1031-1051, illus. Dec. 1939.

Wahlenberg, W. G., Greene, S. W., and Reed, H. R. - Effects of fire and cattle grazing on longleaf pine lands as studied at McNeill, Miss. U. S. Dept. Agr. Tech. Bull. No. 683. 52 pp., illus. June 1939.

Wakeley, Philip C. - Storing southern pine seed on a commercial scale. Southern Lumberman 159 (2009): 114. Dec. 15, 1939.

Winters, R. K. - The magic of the cypress swamp. American Forests 45 (2): 60-64, illus. Feb. 1939.

________________ - Forest resources of the south Louisiana delta. Forest Survey Release No. 42. Southern Forest Expt. Sta. 20 pp. March 2, 1939.

________________ - Fuel wood consumption in the lower South. Jour. Forestry 37 (6): 445-448. June 1939.

________________ - Forest resources of the south Arkansas delta. Forest Survey Release No. 46. Southern Forest Expt. Sta. 24 pp., illus. Sept. 20, 1939.

________________ - In Memoriam - Henry E. Hardtner. (Address presented before Hardtner Memorial Exercises, Urania, La. April 27, 1939.) Jour. Forestry 37 (10): 763-764. Oct. 1939.

Worthington, Robert E. - Costs of tractor logging in southern pine. U. S. Dept. Agr. Tech. Bull. 700. 63 pp., illus. Nov. 1939.

Unpublished Addresses

Chapman, Roy A. - Statistical method and the design of experiments. Annual meeting New Orleans Acad. Sci., March 17, 1939.

Lamb, Howard and Sleeth, Bailey - *Cronartium* spp. on southern pines. Annual meeting New Orleans Acad. Sci., March 17, 1939.

Meginnis, H. G. - The southern road-erosion problem. Forest Influences Seminar, San Dimas Experimental Forest, Glendora, Calif., Feb. 20, 1939.

Nelson, Mary L. and Wakeley, Philip C. - A borderline problem in forestry, physiology, and physics. Annual meeting New Orleans Acad. Sci., March 17, 1939.

Turner, Lewis M. - Forest land use and the soil profile. Forest Soils Section of the Society Soil Sci. of America, New Orleans, La., Nov. 22, 1939.

Verrall, A. F. - Advances in plant cytology during the last 100 years. New Orleans Acad. Sci., Nov. 10, 1939.

Wakeley, Philip C. - An index to the maturity of cones of southern pines. Annual meeting New Orleans Acad. Sci., March 17, 1939.

Winters, Robert K. - Louisiana's forests: Their place in the economy of the State. La. Acad. Sci., Baton Rouge, La., April 21, 1939.

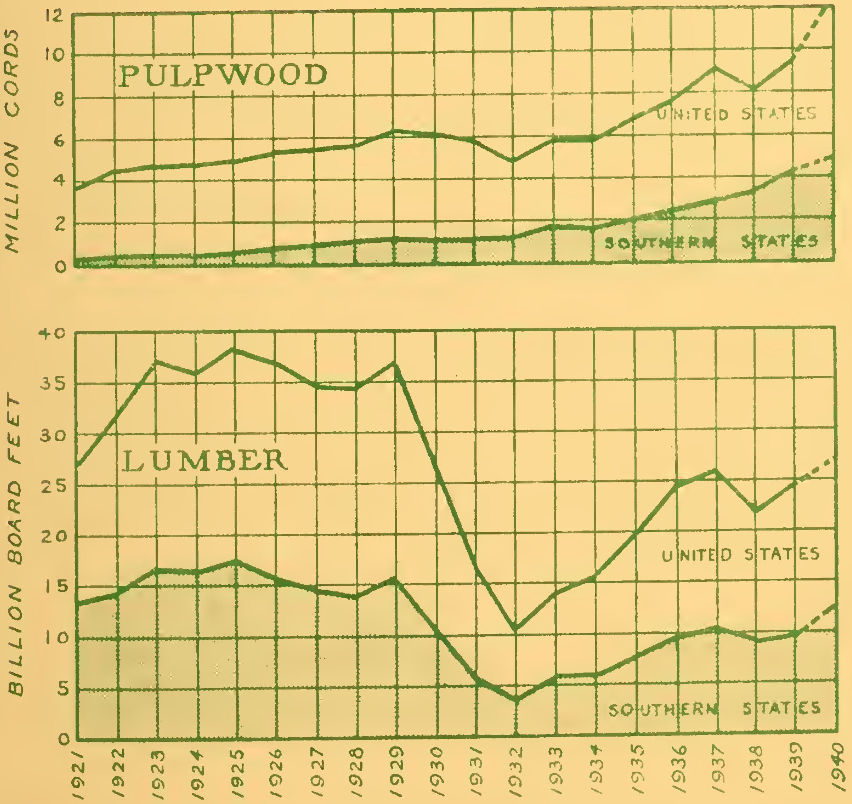
Note: Assistance in the preparation of these materials was furnished by the personnel of Work Projects Administration Official Project 65-2-64-74.

A13.27

AGRICULTURAL REFERENCE DEPARTMENT
CLEMSON COLLEGE LIBRARY

Twentieth
ANNUAL REPORT
# of the
Southern Forest Experiment Station

E. L. Demmon, Director
New Orleans, La.



Trends in Pulpwood and Lumber Production
in Eleven Southern States
Compared With Total United States Production

1940

FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE

CONTENTS

Page

Progress of forestry in the Lower South, 1921 - 1940 . . . 1

1940 highlights 10

Plans for 1941 22

Experimental forests 27

Personnel 28

Publications 33

Unpublished addresses 38

TWENTIETH ANNUAL REPORT

of the

SOUTHERN FOREST EXPERIMENT STATION

January 1, 1940 - December 31, 1940

Progress of Forestry in the Lower South, 1921 - 1940

This 20th Annual Report of the Southern Forest Experiment Station provides an opportunity to review briefly the progress of forestry in the Lower South[1] during the last two decades in an attempt better to appraise the important forestry tasks immediately ahead, and to consider the role of forest research in these concerns. The establishment of the Southern Forest Experiment Station in July 1921, under the directorship of R. D. Forbes, followed the pioneering efforts in the Lower South of a number of foresters, including such leaders as W. W. Ashe, Dr. Austin Cary, Capt. I. F. Eldredge, Dr. Eloise Gerry, W. R. Mattoon, and J. G. Peters of the United States Forest Service, Prof. H. H. Chapman of the Yale Forest School, Major J. G. Lee of Louisiana State University, E. O. Siecke, State Forester of Texas, and others, and of a few far-sighted lumbermen, among whom Henry T. Hardtner of Urania, La., and Col. Wm. L. Sullivan of the Great Southern Lumber Co. at Bogalusa, La., were outstanding.

The first permanent silvicultural plots established in the Lower South were put in by S. T. Dana, assistant chief of forest investigations of the United States Forest Service, at Urania, La., in January 1915. It was natural that the earliest work of the Southern Station should be centered at Urania and Bogalusa, La. Because of limited financial resources, the Station staff numbered only four technical men during its first years. As recognition of the need for accurate basic forestry information became more apparent, the research facilities were gradually expanded, but even in 1940 were still inadequate to fulfill the actual requirements. Before discussing the relation of forest research to the forestry movement in the Lower South, the broad picture of forestry progress will be discussed.

Prior to 1921, forestry had made little headway in the Lower South, although some significant work had been begun. A few timberland owners had initiated simple forest-management practices following surveys of their holdings and the preparation of detailed management plans by the

---

[1] In this report, the Lower South is approximately that section within the boundaries of the Southern Forest Experiment Station territory, and includes the States of Georgia, Florida, Alabama, Mississippi, and Louisiana, as well as southern Arkansas, eastern Texas, and eastern Oklahoma. Forest land in the Lower South totals somewhat over 120 million acres or almost 60 percent of its entire land area.

United States Forest Service, but most of these efforts were sporadic and short-lived. In 1921, there were only two states in the Lower South with active forestry departments: Texas and Louisiana, whose departments were established in 1915 and 1917, respectively. Only one forest school in the Lower South was in operation in 1921, at the University of Georgia, having been established there in 1906. The Southern Forestry Congress, organized by a public-spirited group of foresters, lumbermen, and conservationists, played an outstanding part in stimulating forestry development throughout the South, from its inception in 1916 until its final (12th) meeting in 1930.

In 1921, there were but few national forests in the Lower South. These—namely, the Arkansas, Ozark, Wichita, Alabama, Choctawhatchee, and Ocala—totaled only about a million and a half acres net and were made up largely of unappropriated portions of the public domain, supplemented somewhat through purchases made under the Weeks Law of 1911.

Organized fire protection in 1921, which consisted mainly of seasonal patrol, existed only on the national forests and on somewhat less than 8 million acres of private forest land. The lumber companies providing forestry measures other than fire protection could be counted on the fingers of one hand. A few industrial forestry pioneers, notably Hardtner and Sullivan, had begun to practice conservative cutting, including the leaving of seed trees, and had undertaken some artificial reforestation, but the general run of timberland owners were still unimpressed with the possibilities of growing another crop of timber. What finally sold a number of lumbermen on forestry was the realization that some of the trees they were cutting had grown to maturity since their sawmills were first established.

The last 20 years of forestry developments in the Lower South, briefly recounted here, will be divided into two 10-year periods, 1921 to 1930 and 1931 to 1940.

The decade 1921 - 1930

This period was characterized by the establishment of a number of state forestry organizations, stimulated by a number of significant actions. The study of the national forestry situation made by the United States Forest Service pursuant to Senate Resolution 311 (66th Cong., 2d sess.), introduced by Senator Capper, was published as "Timber Depletion, Lumber Prices, Lumber Exports, and Concentration of Timber Ownerships," June 1, 1920. Interest was aroused as a result of the hearings held in the South by the Committee on National Forestry Policy of the Chamber of Commerce of the United States during 1922, and also the hearings of the Select Committee on Reforestation of the United States Senate (S. Res. 398, 67th Cong., 4th sess.), of which Senator Chas. L. McNary was chairman, held in Florida, Mississippi, and Louisiana in March 1923, which were followed in 1924 by the passage of the Clarke-McNary Act, broadening the provisions of the old Weeks Law of 1911 for cooperation between the Federal Government and the States in fire protection, planting, forest extension work, and forest tax study and reform. Added to these were the public-spirited endeavors of such organizations as the Southern Forestry Congress, the Southern Logging Association, and several state forestry associations.

The discussions of forest conservation at the annual meetings of the Southern Pine Association, and the publicity given this subject by such journals as the Lumber World Review, the Lumber Trade Journal, the Southern Lumberman, and the Naval Stores Review, undoubtedly did much to stimulate public interest in forestry. Of outstanding importance in the forestry movement during this period was the work of Austin Cary among lumbermen and turpentine owners and W. R. Mattoon among the southern farmers. These combined efforts bore fruit in the establishment during this decade of state forestry departments in five additional states in the Lower South—Alabama (1924), Georgia (1925), Mississippi and Oklahoma (1926), and Florida (1928). This left only Arkansas among the group of states without such a department in the year 1930.

This decade also witnessed the establishment of another professional forestry school in the Lower South, at Louisiana State University, in 1925; and the appointment of six state extension foresters: In Georgia, the first state in this territory to take this step (1924), in Alabama and Texas (1925), in Louisiana and Arkansas (1926), and in Mississippi (1927).

With the growth of the state forestry departments, great strides were made in fire protection, which was the chief activity of these organizations. By the end of the decade, there were in the eight states of the Lower South 33,800,000 acres under organized fire protection, or about 23 percent of the total forested area.

The few old national forests were gradually expanded by purchase, and a number of new national-forest purchase units were set up in various parts of the Lower South. By 1930, the area under Forest Service administration had increased from 1.5 to over 2.3 million acres.

Private forestry also advanced during this decade, largely as a result of the increased opportunities for organized fire protection, through cooperative federal and state funds that became available for that purpose. With the gradual cutting out of the original virgin forests and the increasing acceptance of the value of second growth, everywhere there were signs that timberland owners and operators were beginning to realize the potentialities of forest growth. Leaving of seed trees, cutting to a diameter limit, protecting from fire, and in some cases artificial reforestation, appeared as significant steps toward good forestry. Among the larger operations where conservative forestry practices were inaugurated during this period were the following: Brunswick Peninsula Co., Brunswick, Ga.; Superior Pine Products Co., Fargo, Ga.; Sessoms Land & Securities Co., Cogdell, Ga.; Alger-Sullivan Lumber Co., Century, Fla.; Allison Lumber Co., Bellamy, Ala.; Jackson Lumber Co., Lockhart, Ala.; Crossett Lumber Co., Crossett, Ark.; Dierks Land & Timber Co., (holdings in Arkansas and Oklahoma); Long-Bell Lumber Co., (holdings in Arkansas and Louisiana); Union Saw Mill Co., Huttig, Ark.; Industrial Lumber Co., Elizabeth, La.; Southern Pine Lumber Co., Diboll, Tex.; and two pulp and paper companies: The Brown Paper Mill Co., West Monroe, La., and the International Paper Co. (Southern

Kraft Corporation), with holdings in Arkansas, Louisiana, Mississippi, and Alabama.

When Federal forest research in the United States was instituted on a regional basis in July 1921, the Southern Forest Experiment Station was one of the first three such stations to be organized. During the following years, as the forestry movement gained headway, and the need grew for more accurate knowledge of the forest resources and of the methods of growing new crops of timber, the size and complexity of the research job gradually became more apparent. The public interest in this work finally led to the passage of the McSweeney-McNary Forest Research Act in May 1928, which marked a milestone in the progress of forest research.

The decade 1931 - 1940

Although much progress had been made during the previous decade, southern forestry took on new life along all fronts during the 10-year period beginning with 1931. Among the stimulating influences of this latter period were the national forestry picture presented by the Forest Service in its comprehensive report "A National Plan for American Forestry" (Copeland Report) in 1933; the greatly expanded program of federal acquisition of land for national forests and of increased fire protection on federal, state, and private lands as a result of the establishment of the Civilian Conservation Corps in 1933, and of other emergency relief organizations which furnished labor and materials for forestry programs; the formulation of minimum forest conservation practices under Article X of the Lumber Code (under the National Industrial Recovery Act) in 1933 and 1934, and the setting up of conservation agencies by the trade associations representing the pine, hardwood, and cypress industries in the South; the voluntary adoption of specific forest conservation practices by the representatives of the southern pulp and paper mills in 1937; and the open hearings before the Joint Congressional Committee on Forestry held in Jacksonville, Fla., in November 1938, and in Mobile, Ala., in November 1939.

Rapid expansion of the national-forest program in the South made a new regional administrative office necessary. Region 8 headquarters were established in July 1934 at Atlanta, Ga. Aside from administration of the national forests, which had increased to 6,716,188 acres in the Lower South by June 30, 1940, one of the most important activities of the Atlanta office lies in the stimulation of private forestry practice through its Division of State and Private Forestry.

Fire protection activities continued to increase until in 1940 there were over 57 million acres of forest land in federal, state, and private ownership under organized protection in the Lower South. Notwithstanding this progress, over 50 percent of the forest land in this region is at present without organized fire protection.

Some of the stimulation given southern forestry during this decade came about as a result of the phenomenal expansion of the pulp and paper industry in the South. In large part as an outcome of the pioneering research work of the United States Forest Products Laboratory at Madison, Wis., and the stimulating influence of Dr. Charles H. Herty, this industry has not only taken national leadership in the production of kraft paper and board, of which it now produces 80 percent of the United States requirements, but has also branched out into the fields of white paper, newsprint, and rayon. The capacity of wood-pulp production in the 11 southeastern states has been increased rapidly; in 1940 it exceeded 3 million tons annually, using about 5 million standard cords of wood, and accounting for approximately 40 percent of the total United States production of pulp. To the South, one of the most hopeful aspects of this developing industry is the opportunity it offers for the utilization of available raw material not needed by other forest industries. At present it consumes only about 5 percent of the total drain on southern forests. With all the advantages the South offers—great areas where soil and climatic factors favor rapid tree growth, a great number of widely used pine and hardwood species, ease of logging, availability of ample labor with low living costs, nearness to markets, excellent rail and water transportation facilities, and accessibility to fresh water, chemicals, and power—there is every reason to expect even greater growth in the pulp and paper industry. Such expansion, if carried out sanely and with due regard for factors of long-time investment, will be of great permanent value to the South, assisting the economic and social betterment of its people.

Appraising the progress of forestry is not an easy task. Undoubtedly, much forestry is being practiced, respecting which no records are available. The latest data on the area of land under good forest management, compiled by the United States Forest Service in 1938, indicated that over 13 million acres of commercial forest land in industrial and other private ownership (not including farm ownership) in the Lower South was being managed with the objective of continuous production. Of this, the pulp and paper mills own over 3 million acres, capable of producing about half of their raw-material requirements. Many of these large forest-land owners have hired technically trained foresters; their holdings, along with the national and state forests, are serving as examples of good forestry practice. A few municipal forests have also been established.

The work of the state and extension foresters in the Lower South has contributed in no small degree to the advances made in forestry during the past decade. State forestry departments had been set up in all the states of the region by the early 1930's. Although the Arkansas state legislature authorized a State Forestry Commission in 1931, it was not until 1933 that funds were made available to employ a state forester, making the list complete. State extension foresters were appointed in Florida in 1938 and, lastly, in Oklahoma in 1940. The forest schools have also made contributions to forestry progress, and during this decade one additional professional forestry school was organized—at the University of Florida, in 1935.

Despite progress made since 1921, the 1940 situation is not one to cause great exultation, although each year the picture has become somewhat more encouraging. Over 50 percent of the forests of the Lower South still lack organized fire protection, with the result that about 20 percent of the total forest area is burned over each year. Most of the present forest stands are greatly understocked and are producing but a fraction of their potential capacities. Too much cutting is still done with little or no regard for the future, particularly in the operations of the thousands of small portable mills in this region. Many millions of acres of southern forest lands are in need of planting if they are to grow timber crops within any reasonable period and adequately safeguard soil and water resources. Markets are lacking for great quantities of low-grade material and of little-used tree species and for the potential production of naval stores (turpentine and rosin). All in all, southern forest lands, under good management, are capable of providing continuous employment and hence higher standards of living for at least double the number of persons they now support. The idleness or only partial use of many millions of acres of southern forest land, unsuited to or not needed for farming, represents a great economic loss to the region and to the United States. To take full advantage of the opportunities offered by its forests, the South needs additional forest industries and remanufacturing plants, effecting a higher degree of processing, and the production of more goods for the consumer market. It also needs, now more than ever before, an outlet for the surplus of labor resulting from the decline of its main source of cash income, cotton. Not only did the cultivated area of cotton in the 13 southeastern cotton-producing states decline from a peak of 46 million acres in 1925 to less than 25 million acres in 1940, but the recent losses in export markets caused by the war will undoubtedly result in further reductions in cotton planting. This displacement of land and labor from the chief cash crop of the region points to a tragic need for readjustments in land use and for additional opportunities for employment. In any such readjustment, the South's forest lands, occupying 6 out of every 10 acres of its present land area, should be utilized to the fullest extent. Application of such a program, however, is not simple: it involves cooperation by many agencies in the careful drafting and execution of such plans as will insure that both the land and its resources are utilized conservatively and for the greatest good of all the people.

Research and forestry progress

Little has been said thus far of the place of research in the progess of forestry in the Lower South. Research contributions have been made by some of the state forestry departments, the forest schools, the forest industries, and such organizations as the United States Forest Products Laboratory, but the discussion here will be confined to federal forest research at the Southern Forest Experiment Station. Although at first glance Southern Station contributions may seem more or less obscure, because they have not been especially spectacular, they have unquestionably helped to prepare and smooth the way for Southern forestry progress. These contributions have been made in a number of ways. The Southern Forest Experiment Station staff has prepared and distributed a great number of timely reports containing current findings based on its studies, thousands of letters of advice and guidance have been written in response to inquiries, numerous talks and addresses have been delivered before a variety of different groups, many conferences have been held with people desiring forestry information based on research findings, frequent demonstrations on the Station's nine experimental forests and at other centers of Station work have been arranged, and cooperation has been extended to public and private forestry agencies throughout the South, all of which taken together must have exerted a real influence on the development of better forestry practices. Many Station contributions to the knowledge and techniques of Southern forestry are now in wide use throughout the region.

Starting in 1921, with a handful of forest technicians, new to the job of research, the Station has gradually expanded and carried through a definite program aimed at determining the scientific basis for sound forest management. During the period from 1925 to 1935, the Station received material aid in the consideration of its annual programs from the Southern Forest Research Advisory Council, a group of 21 business, professional, and scientific men appointed by the Secretary of Agriculture and representing the forest and allied industries in the Station's territory. Since the Station was established, it has gathered and disseminated much preliminary information, but because timber growing is such a long-time enterprise, and because of the great diversity of soils, forest types, land uses, and economic conditions in the Station's territory, embracing as it does over 120 million acres of forest land, much vital information essential for permanent, successful forest-land management is still lacking.

The following brief summary covers its principal forest research contributions to southern forestry to date:

Forest management. From the first, Southern Station studies were centered around the problems of obtaining good silviculture and forest management, principally with the southern pines. Volume and yield tables for the four principal southern pines were prepared; studies of methods of thinning, improving, and cutting to obtain adequate natural reproduction and optimum growth of stands have yielded preliminary information; seed procurement, nursery, and planting techniques have been developed; conservative methods of extracting naval stores from longleaf and slash pines were worked out; and problems of fire behavior and control, fire effects, and use of fire for silvicultural purposes have been partially determined.

Forest economics. Beginning in 1929, exploratory studies of the costs and returns of timber growing have yielded definite information on the highly important economic aspects of forestry, and have undoubtedly influenced some private companies to make investments in forestry enterprises. Questions of taxation and tax delinquency have also been explored and the findings publicized.

Forest Survey. This activity, beginning in 1930, has contributed the first authoritative appraisal of the Lower South's forest resources—its volume, growth rate, and rate of depletion—and the measures necessary to insure its greatest usefulness to the economic and social future of this region. This has been done by current release of its findings, through reports on 30 survey units, ranging from 4 to 10 million acres each, and in other ways. Efforts are being made to keep this information currently accurate in order to provide public agencies (federal, state, and local) as well as private industry with an understanding of the opportunities and limitations presented by the forests, and to give the basis for plans for a sustained supply of forest materials.

Forest influences. Since 1929, this project has contributed to our knowledge of how forests influence soils and water, and has developed simple, practical techniques for the control of water run-off and soil erosion on non-agricultural lands. These findings have had direct application on large projects concerned with the reforestation of gullied lands and associated watershed-improvement measures. Highly effective methods of stabilizing roadbanks and of controlling other forms of erosion from highways have also been developed in these investigations.

Flood-control surveys. Since 1937, in cooperation with other bureaus of the Department of Agriculture, preliminary flood-control studies have been completed in 17 major drainage basins in the Station's territory, and detailed surveys have been, or are being, made of the watersheds of the Trinity, Washita, Colorado, Neosho-Grand, lower Arkansas, White, and Yazoo Rivers. Survey findings are contributing in many ways to better forest-land management by developing specific programs of land treatment that are designed to alleviate flood damage through the retardation of water run-off and the prevention of soil erosion.

A look ahead

The past two decades have seen substantial and encouraging growth in the practice of forestry in the Lower South. This progress, however, has been only a start toward the goal of intensive use of the 120 million acres of forest land in this region. But 20 years, after all, is a relatively short period in the life of a tree or a forest, and shorter still in the life of a nation. Let us be encouraged, therefore, by the substantial progress made and the visible results obtained. Certainly, with increased forestry practice in this region vital to its future economic security, with such an enormous area of land available and apparently suitable for no more intensive use, and with so much to be learned about the technique of timber growing, there can be little question about the need and urgency of an adequate program of forest research.

What about the next 20 years? It is perhaps idle to speculate too long on the future, yet there must be earnest consideration of trends if a research organization is to develop a program for supplying information in advance of needs. It seems logical that forestry in the Lower South will continue to advance along all lines during the coming years.

In the field of silviculture and management, much additional information is needed concerning (1) regeneration of each major species and of mixed stands under various methods of cutting; (2) the most efficient methods of fire protection and its cost as compared to the value of the resource protected, for various types, conditions, locations, and patterns of ownership, as well as methods of using fire as a silvicultural tool; (3) the silvicultural methods which will yield the maximum volume of wood in most utilizable form from the standpoint of economic returns; and many other associated problems.

A pressing question is: What shall we do with our southern hardwoods? Much intensive research in all phases of hardwood forestry—

silviculture, utilization, economics—is required. The fact that hardwoods make up 59 percent of the total cubic volume of all timber in the Lower South and that pure hardwood types cover more than 43 million acres in area (28 million acres of bottomland and 15 million acres of upland) are important considerations in this connection.

Again, land classification, a truly tremendous job, is needed to provide sound, workable, and profitable development of land to its most productive, remunerative, and socially desirable use. Other objectives are to determine the proper spheres of private and public ownership, and to survey the boundaries between governmental cooperation and some measure of regulatory control. This is a task which confronts all land-use agencies of the Federal Government, working in collaboration with State, county, and municipal agencies, and with private citizens. A host of unanswered questions face forest research agencies in this field, and an adequate land classification based on sound research can best answer many of them. A start along this line is being made by the county land-use planning committees, but at the present rate of progress it will be another 10 years before all counties will have been considered.

Intimately connected with this question of best land use is the need for proper watershed management in the control of soil erosion and floods. Investigations are under way in only two localities at present, and although useful contributions have been made, little more has been done than to explore some of the problems in this field that require investigation. Furthermore, within the Station's territory there is an enormous area of forest land, especially the great expanses of non-commercial scrub forest in Texas and Oklahoma, in which even the problems of watershed management are as yet imperfectly recognized.

The private timberland owner and operator, who at present controls 93 percent of all forest lands in the Lower South, has one important question always in the forefront of his mind: "Will forest management for sustained yield give me a reasonable return on my investment?" Obviously, the answer is dependent on many factors, and cannot be given until the conditions in each case or in representative cases are known and properly evaluated. Economic research is designed to provide knowledge of the effect of those factors on typical operations in a wide diversity of locations, forest types, and conditions, and for various products.

There seems no doubt that the South will continue to show progress in forestry practice, unless our whole world is turned topsy-turvy. In the present national effort towards defense, southern forests are playing an important part, contributing much-needed lumber, naval stores, paper, and other products, as well as sites for army camps and training maneuvers. Their contributions in the period of adjustment that will follow the present emergency should be even greater, through providing a backlog of employment for the million or more workers whom they are capable of supporting under conditions of full productivity and use. Their value for control of floods, for public recreation, and for wildlife should not be overlooked. In all projected forestry programs, forest research can stimulate and promote a better understanding of the part forests can contribute to the better security of the people of the Lower South and of the Nation.

A few of the highlights in the progress of forest research at the Southern Station during 1940 are presented in the following pages, together with a resumé of plans for 1941.

1940 Highlights

Lower South depends heavily on its primary wood-products industries.

Who would think, as he travels over the highways of the Lower South, that back in the hinterlands, usually off these main roads, are the enormous total of more than 8,000 sawmills in operation? Nine out of ten of them are small establishments whose individual capacity is almost insignificant, yet together these little mills cut more than half of the lumber produced in this region. Keeping current the information as to developments in the forest industries is one of the duties of the Forest Survey. It finds that the number of small portable mills is steadily increasing, while the larger mills, many of which are operating on a forest-liquidation basis, are growing fewer with the passing of the years—and of the old-growth timber.

The Survey also finds that the sawmill industry is keeping up with the times by modernizing its equipment. With the disappearance of virgin stands and the development of second-growth saw timber, the logging railroad has given way in large measure to the truck as a means of log transportation; gasoline tractors are replacing steam skidders, and, in some cases, animal-drawn equipment.

The outstanding industrial development in the Lower South in recent years has been the growth of the pulp and paper industry. Since 1935, 15 large new mills have been completed or are under construction, more than doubling the amount of pulpwood used. This development is still continuing, for in 1940 three new mills started operating and construction was begun on two other mills.

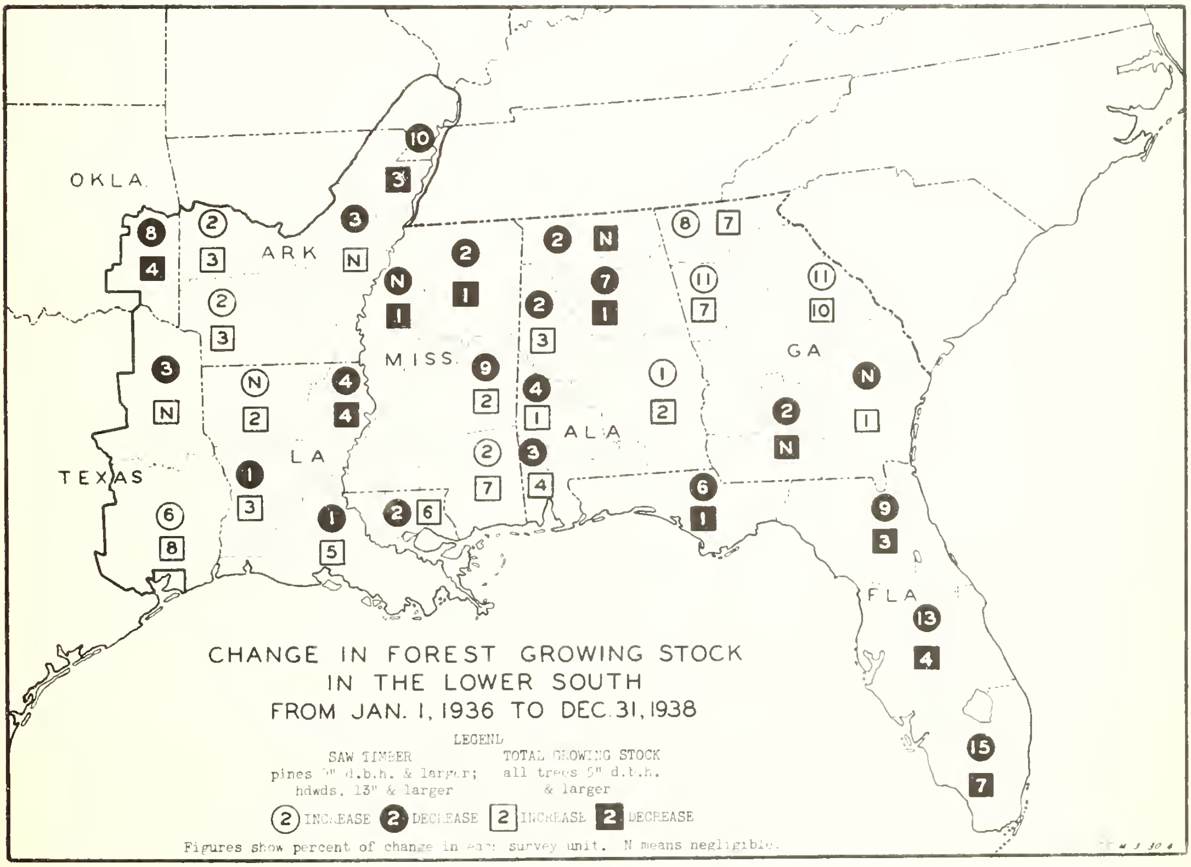
Forest utilization in the Lower South ranks high in the industrial economy of the region. Changes that are taking place in the composition of the forest stands are working to diversify and alter the character of this industry. Scattered stands and the utilization of second-growth timber favor smaller sawmills, often portable and transient, using trucks, light gasoline skidders, tractors, and similar equipment. Concentration yards for the storing, seasoning, grading, finishing, and marketing of the rough lumber produced by these small mills are increasingly prevalent. A considerable degree of competition for timber that would some day make saw-log material has been caused by the recent expansion of the pulp and paper industry, by virtue of the market it creates for the small trees. This competition is being further increased because of the outright purchase by these companies of forest land, upon which cutting may be restricted and the supply of standing timber withdrawn from the open market.

Growth and drain in southern forests nearly balanced in 1936-38.

Net effect on the region's forests of gains from growth, losses from mortality, and removal for use in the 3-year period from January 1, 1936 to December 31, 1938, is summarized in the figure below, which shows changes in the growing stock, both in cords and in saw timber, by survey units. In this period, the cordwood volume of the growing stock of all trees 5 inches and larger registered a 2-percent increase for the region as a whole; therefore, insofar as total growth and total drain are concerned, it appears that the forests are operating at very near a balance. As for saw timber, however, drain exceeded growth by about three-fourths of 1 percent in the same 3-year period.[2] Furthermore, conditions in regard to the highly important matters of timber quality and presence of the more valuable species are not all that could be desired.

---

[2] The situation varies in the different survey units and may also vary widely within a unit.



CHANGE IN FOREST GROWING STOCK IN THE LOWER SOUTH FROM JAN. 1, 1936 TO DEC. 31, 1938

The general practice long has been, and today still is, to cut all of the trees that can be used to advantage and at a profit, and to leave the trees of small size, low quality, and less valuable species. Regardless of the soundness of the reasons put forward to justify such practice, the result has been that the proportion of mature, slowly grown, high-grade timber of desirable species has been reduced to a fraction of what it originally was, and the proportion of immature timber, understocked stands, low-grade trees, and less valuable species has been tremendously increased.

Marking rules developed for improvement cuttings in bottomland hardwoods.

After fire protection and the elimination of timber trespass, the outstanding need in southern bottomland hardwood forests is for improvement cuttings—to remove the numerous trees that are not increasing in value, to hasten the growth rate of promising trees that are, and to provide space for new trees of good quality and species. The problem of how best to make such cuttings in bottomland hardwoods is especially complex because of the large number of species, the great amount and variety of defect, and the generally poor market for low-grade material. Rules and recommendations for marking trees to be removed in improvement cuttings in Delta bottomland hardwoods have been worked out from studies conducted during 1940 in cooperation with the Mississippi Farm Forestry Research Project. Cutting was completed on the experimental plots on the Delta Experimental Forest that provided the laboratory for developing these marking rules. The demonstration value of the plots has been greatly enhanced by the permanent marking of trees on an uncut or check plot to show four different degrees of improvement cuttings, and by signs telling exactly why individual trees were marked to be cut or to be reserved for further growth.

Alabama study indicates best conditions for loblolly pine reproduction.

Surveys in Tallapoosa and Autauga Counties, Ala., undertaken because of the acute management problem confronted in maintaining pines against encroaching low-quality hardwoods in the shortleaf-loblolly-hardwoods type, now make it possible to describe with fair accuracy the conditions necessary for satisfactory reproduction of shortleaf and loblolly pine. Surveys were undertaken in cooperation with the Alabama Agricultural Experiment Station as the first study under the Norris-Doxey Cooperative Farm Forestry Research Project in Alabama. The results are important not only because they permit more intelligent forecasts of natural reproduction and better specifications for cutting, but also because they greatly improve the precision and reliability of detailed experiments now being undertaken in the maintenance and increase of pine reproduction in mixed stands.

The surveys comprised full descriptions of pine reproduction and the factors affecting it on 217 randomly selected areas, about equally divided between the 2 counties. One county is in the Piedmont and one in the Upper Coastal Plain Province. The findings in the 2 counties were practically identical with respect to seed supply required (10 good trees per acre for prompt reproduction; at least 3 for good reproduction over several years), and in the effects of erosion, grazing, and fire. Slight differences were apparent in the effects of brush and small hardwoods, and in the degree of overhead shade under which adequate, thrifty pine seedlings became established.

The conditions found on the 217 plots also confirmed earlier estimates of the urgency of the pine reproduction problem. Less than one-sixth of the plots were well enough stocked to require no extensive reproduction. Of the plots in need of reproduction, nearly 80 percent had inadequate reproduction of pine, or none at all.

Use of compost recommended for forest nurseries.

At the Stuart Nursery, in central Louisiana, compost was tested in applications of 1, 2, and 3 inches to beds of longleaf and of slash pine seedlings in densities of 10, 20, 30, 40, and 50 per square foot. The compost consisted mostly of rice straw treated with small amounts of ammonium sulfate, rock phosphate, and lime, and subjected to decomposition for about 7 months. The study occupied, in all, four nursery beds 4 x 100 feet; the smallest unit given one combination of compost, density, and species was 4 x 5 feet. In check beds no compost was applied. The work was completed in 1940.

The results of the treatments were evaluated on the basis of measurements of top length, stem diameter, root length, root extent, green weight, and plantable percentage. General notes on seedbed conditions and seedling development were also made. One outstanding result was that seedlings treated with compost were definitely superior in size to those not so treated. There appeared to be little or no difference in the effects of the three rates of compost application tested; 1 inch of compost was as effective as 2 or 3, indicating that the point of diminishing returns with respect to cost and effect may coincide with an application less than 1 inch in depth.

The density phase of the experiment indicated that, in general, the size and grade of the seedlings decrease as the density of stand increases. Every increase in density resulted in a significant decrease in plantable percentage. The study further indicated that if the soil fertility is improved by the use of compost, desirable seedlings may be grown at greater than ordinary densities. It thus points the way to increased economy of operation of the large federal and state nurseries in the southern pine region, and to considerable technical improvement in such work.

Experimental spacing plantations yield valuable data.

Slash pine plantations established at Bogalusa, La., in 1924-25, at spacings of 8 x 8, 6 x 6, and 5 x 5 feet, were thinned experimentally in 1940, and the thinnings were used commercially for pulpwood. The wood was scaled under the locally prevalent close pulpwood utilization for plantation thinnings, which accepts some smooth sticks as small as 4½ inches inside bark. The results emphasize the superiority of the closer spacings. The yields actually going into commercial pulp were as follows: 8 x 8 foot spacing, 3.03 cords per acre; 6 x 6, 7.55 cords per acre; and 5 x 5, 8.15 cords per acre. Even more noteworthy are the differences in the stands left after thinning. The total numbers of trees left per acre were: 8 x 8, 434; 6 x 6, 519; and 5 x 5, 629. Notwithstanding the slower diameter growth of the 5 x 5 plantation because of earlier crowding, the numbers of trees in the 5-inch diameter class and larger that were left after thinning were: 8 x 8, 322 trees; 6 x 6, 361 trees; and 5 x 5, 441 trees per acre. Other advantages of the 5 x 5 over wider spacings are that the slower diameter growth is producing wood of finer grain, and the lower branches up to higher points on the stems are dying and being shed. The trees felled in thinning cleaned off the dead branches best in the 5 x 5 plantation. Furthermore, in the 5 x 5 marking for thinning was easier; fewer large, wasteful openings were made; and forked, crooked, limby, and disease-infected trees were more easily removed without making irregularities in the remaining stand.

Cottonwood wildings make good planting stock.

Most cut-over areas in the bottomland hardwoods do not require planting in order to become at least moderately productive. Cut-over lands in this type that do need planting, however, offer a very difficult problem because of the tangled jungles of buckvine, other vines, weeds, shrubs, and undesirable tree species that usually follow heavy cutting and frequent burning. Obviously, fast-growing species are likely to be most successful in overcoming this competition; therefore cottonwood—one of the fastest-growing trees in the country—has been used in the first planting experiments on the Delta Experimental Forest. Both cuttings and wildings (wild seedlings) were tested during 1940, and the wildings proved by far the more successful. Wildings planted just before growth started in the spring showed from about 50 to 70 percent survival, depending on the site, at the close of their first growing season in plantations. Since in most cases the plants that survived the first year are 4 to 7 feet high and are not overtopped by other vegetation, further mortality is expected to be small.

Sodium arsenite is effective in killing scrub oaks.

In killing the crowns of undesirable trees or removing them altogether for stand improvement, it is often immaterial whether or not the trees sprout below the point of cutting or girdling. In releasing longleaf pine reproduction from hardwood competition, however, the prevention of sprouting from cut or girdled scrub oaks is important because of the delayed height growth characteristic of longleaf pine, and the great vigor of scrub-oak sprouts. Experiments carried on during 1940 on the Harrison Experimental Forest show that scrub oaks can be killed and sprouting either eliminated or greatly reduced by pouring a strong solution of sodium arsenite into holes in the stem or in the largest roots just below the ground surface. The holes, $\frac{1}{2}$ inch in diameter and about 1 inch deep, can be made either with an augur or with a special tool designed by the Station.3/ One hole is usually sufficient

---

3/ Briefly described in Southern Forestry Notes No. 38, March 1941, issued by the Station.

in trees less than 3 inches in diameter; larger trees require two or more holes. This method is recommended only for areas where it is practicable to exclude livestock, however, since sodium arsenite is a deadly poison to animals as well as to plants. A promising method for killing scrub oaks where it is not safe to use sodium arsenite is to remove the bark from the lowest 18-inch sections of the stems. The trees are killed slowly, but sprouting is effectively reduced.

Volume growth accelerated by selective cutting.

An acceleration of growth rates of from 9 to 22 percent took place on 3,000 acres of loblolly and shortleaf pine in Arkansas during the 6 years following selective cutting in 1934. Loblolly pine grew approximately 46 percent faster than shortleaf, and the larger the trees the greater the growth rate. Growth rates for the various types and classes represented ranged from 5.2 to 9.1 percent. Based on 1940 stumpage prices for logs of the various grades, the net value of the growth per acre per year varied from $0.59 for the lighter and poor-quality stands to approximately $2.70 for the better-stocked and high-quality stands.

Another area selectively cut in 1937 grew 332 board feet per acre per year through 1940 or an increase in volume equivalent to 9.8 percent simple interest. At $8.00 per M board feet the gross value of the growth per acre per year was $2.66. With yearly expenses amounting to $0.25 per acre, the net value of the growth would be $2.41.

Old-field shortleaf and loblolly pine stands improved by thinning.

Three years after thinning a dense old-field stand of 44-year-old shortleaf and loblolly pine in southern Arkansas, on one of the Station's spacing and yield study plots, it was found that the best net growth, in cords per acre per year, had occurred in stands in which the reserved trees were spaced approximately 15 feet apart. In fact, the net growth in such stands was more than three times that in the unthinned stands or check plots. Trees which were co-dominant at the time of thinning developed as much crown during the subsequent 3 years as did the previously dominant trees. In other words, the co-dominants of 3 years ago have developed their crowns much more rapidly than have the dominants of 3 years ago. This indicates that the thinning of the usually rough dominant trees, leaving the smaller but smoother co-dominant trees, is a very desirable practice. The trees on all areas thinned to 100 or fewer stems per acre produced an abundance of seed during the third and fourth years after the thinning and are now well stocked with 1-year-old reproduction. The unthinned stands and those thinned very lightly, as is usual in uncut old-field stands, produced little seed during the years since the cutting.

Chemical treatment increases naval stores yields.

A report was issued on the recent studies in which chemical solutions were applied to streaks immediately after chipping. The results indicate such favorable increases in gum production, particularly from slash pine, that further investigative work on an expanded scale has been commenced. The experimental trees, both longleaf and slash pine, were subjected during 1940 to a full season of preliminary chipping to provide gum yield records that will make it possible to assort the trees accurately into equal-yielding groups. Various concentrations of hydrochloric and sulfuric acid will be applied to streaks ½ inch high for several full seasons, beginning in 1941, in order to establish definite trends and superiorities. Managers of two large forests and numerous smaller naval stores operators are making plans for semi-commercial trials of the most promising treatment to date (20% sulfuric acid, which increased yields from slash pine up to 70%) during the 1941 operating season.

Type of road has marked influence on costs of hauling logs.

It costs approximately four times as much to haul a unit of pulpwood or a thousand board feet of logs a mile on ungraded woods road in northern Louisiana, eastern Texas, or southern Arkansas as it does to haul the same load a mile on well-graded gravel road. Furthermore, it costs approximately twice as much to haul such loads a mile on graded dirt road as it does to haul them the same distance on well-graded gravel. A report on the relationship of kind of road traversed to the production costs for pulpwood and logs was issued during 1940 and attracted wide interest.

Forests of central and north Alabama offer industrial opportunities.

Central and north Alabama, favor by the coal fields of the Birmingham area and the power development of the Tennessee Valley Authority to the north, comprise areas admirably adapted to programs of forest industrial development. Here is a section where thousands of small owners are seeking a better living and a few large landowners have an opportunity to demonstrate the feasibility of sound land management. The two national forests in this area are representative of all of the forest types and conditions found here; many large landowners, although primarily interested in sub-surface rights, are taking steps to manage their forest resources for continuous yield. This is an encouraging sign in an area where forests have been severely overcut for years until they are today largely made up of small trees of low quality, decreasing in value every year.

Nearly 60 percent of central and north Alabama is in forests, and the Forest Survey, in three releases issued in 1940 dealing with this area, estimated the growing stock at 16½ billion board feet, of which more than two-thirds was pine. This growing stock, however, is not nearly adequate to keep up with the cutting of man and the inroads of fire, for in 1937 such drain exceeded growth by more than a quarter-billion board feet. Mortality, caused by fires, insects, disease, and natural crowding out, alone accounted for nearly 200 million board feet; a large part of this could be eliminated through fire protection—a fundamental part of any forest-management program.

This is a region of scattered stands of young trees, where large or medium-sized sawmill operations are impracticable. In 1937 there were more than 1,500 small sawmills skipping from one stand to another, picking out the best trees, usually the pines, and leaving the lower-quality individuals and less valuable species behind. More intelligent cutting practices must be demanded by the landowners, and industries must be sought to provide markets for the low-grade hardwoods that are now cluttering up these forests. The large proportion of young stands, nearly 50 percent of the whole forest area, adds hope to prospects of increased industrial development in the future, which should make an expanding contribution to the social and economic welfare of this section of Alabama.

Post oak belt of east Texas is an important local asset.

Less than 150 miles of travel takes one westward through Texas into a transition zone between the pine forests of the east and the brushy plains and treeless prairies. This transition zone, shaped like a Texas boot with its top near the Red River and its toe nearly 500 miles to the southwestward, is known as the east Texas post oak belt. Although it is chiefly agricultural, with cotton, corn, and livestock as the principal products, nearly 38 percent of its area is covered with hardwood forests. These woodlands are highly valuable to the farmer as a source of fence posts and fuel wood, some of which provide a supplementary cash income when shipped to the cities. The forests benefit the farms additionally by reducing erosion and retarding run-off of the not too abundant rainfall.

An extensive survey of this area was made in 1937, but the report was not issued until 1940. Although the forest is characterized by short-boled, bushy trees of the scrub-oak type, it is estimated that there are over 33,000,000 cords of usable wood in the standing trees. The post oaks may acquire new value through development of the pulp and paper industry. Already Texas post oak mixed with pine sulfate pulp has been used to make coated magazine papers on a commercial scale. Vigorous efforts by private owners and State and Federal forestry agencies are needed to give the forest better protection from fire and overgrazing and to introduce other good management practices so that its usefulness and value can be increased.

Forest taxation in Mississippi and Alabama varies greatly by counties.

A Station study during 1940 in seven representative counties of Mississippi revealed that the ad valorem property taxes on forest land and timber levied in 1939 for State, county, school, and road purposes (excluding drainage and levee taxes) averaged, for the seven counties, from $17\frac{1}{2}$ to $22\frac{1}{4}$ cents per acre on sawlog stands for various forest types. Very little difference was found in taxes on under-sawlog-size and cut-over tracts, whether pine or hardwood; the average being $15\frac{1}{2}$ cents per acre. Wide variation among the individual counties was in evidence, however; those counties with badly depleted forests and a declining agriculture had taxes frequently double or even triple those of counties where, because of better forest management or ownership pattern, the forest and forest enterprises provide a more stable tax base. It is interesting to note that in 1940 Mississippi took steps to remedy the situation of unequitable taxes on forest property. A new severance tax law, effective June 1, 1940, exempts all standing timber from ad valorem taxes but imposes a 3-percent tax on the value of the unmanufactured products at the time and place of severance. This law should result in a more favorable relation between taxes and income from forest properties.

Another Station study, in Alabama, showed that the average tax per acre in nine counties studied is about 6¼ cents per acre. The reasons for the low level of taxes in Alabama as compared with those in Mississippi are: (1) Local governments less comprehensive as to function and more heavily State-subsidized, the State deriving most of its revenue from sources other than property taxes, and (2) a constitutional tax-rate limitation of 21 mills as the maximum total levy of all units of government, except for amortization of long-standing bonded debts in a few counties.

Farm-woodland cash returns can be multiplied, with good management.

Studies of sample farm woodlands in Washington Parish, La., and Hempstead County, Ark., in cooperation with the Bureau of Agricultural Economics and state agricultural experiment stations, have helped to evaluate the present and potential contribution of the typical small farm woodland to the general farm economy. In Washington Parish, La., the usual two-mule cotton farm averages about 60 acres, of which woodlands comprise about 25 acres, composed chiefly of loblolly pine and hardwoods. The farmer cuts annually about 11 cords of fuel wood and 60 fence posts, and because these products are commonly cut from the best pines and hardwoods the growing stock has been depleted to less than 1,000 board feet of saw timber per acre. During the past 10 years, the annual cash sale of forest products amounted to only $4 per farm. In spite of mistreatment, however, farm woodland has restocked to a fair stand of young pine, and with good management, including light selective cuttings at 5-year intervals, the average 25-acre woodland during the next 30 years should yield cash income varying from $50 for the first 5-year period to $160 for the sixth period, or $0.40 to $1.28 per acre per year, besides supplying the farmer's fuel-wood and fence-post requirements. After 30 years of periodic cutting and management, it is estimated, the growing stock would be about 3,000 board feet per acre.

Considering the probable yields and income from the best 10 percent of the better-stocked stands, it is estimated that under good management, the sale of forest products could be increased gradually over a period of 50 years and yield from $1.28 to $2.76 per acre per year. Such an income would add substantially to the present low cash income from all other farm enterprises, which approximates $250 annually.

The study showed that on 146 days of each year the farmer is not busy on any farm enterprise. This would give ample time to cut and manage 200 acres of woodland. With this acreage and 3,000 feet of saw timber per acre, the farmer could cut and sell annually during the first 5 years sawlogs, pulpwood, and ties valued at $330, with no additional outlay for labor and equipment. The only additional expenses would be taxes on about 70 acres——the excess over the 160-acre homestead now exempt from taxes under Louisiana statutes. This expansion in size and improvement through management of the farm woodland appears as a promising farm adjustment in Washington Parish, La.

Control of highway erosion on the Holly Springs National Forest planned.

A detailed survey of 75 miles of forest roads on the Holly Springs National Forest disclosed that almost 2 million square feet of eroding backslopes on rights-of-way are in need of stabilization measures, not to mention lesser areas of road fills and berms requiring similar erosion-control treatment. During 1940, the Station prepared a complete project plan for the control of erosion along these forest roads on the Holly Springs forest, embodying plant-fixation methods developed in research trials at Holly Springs during the past 5 years. The cost of the program is estimated at $562 per average mile or a total of $42,402. Eighty-four percent of the cost is for labor, and the work can be accomplished under the CCC program with a total non-labor outlay of less than $7,000. Treatments include the sowing of 1,270 pounds of Bermuda grass seed and 732 pounds of Korean and common lespedeza seed, the use of 423 truckloads of sod materials and 19 tons of fertilizer, the planting of 73,000 pine seedlings, and the hauling and application of large quantities of topsoil, mulching materials, etc.

Holly Springs studies demonstrate that untreated roadbanks lose about 3/4 ton of soil annually per hundred square feet of eroding surface. At this rate, the barren banks on the 75 miles of surveyed roads lose each year the huge total of almost 29 million pounds of eroded soil, plus the soil lost from the actual roadbed. Furthermore, the 1,600 miles of roads of all classes within the Holly Springs National Forest, if undergoing erosion at a like rate, contribute each year not less than 300,000 tons of sediments to streams and adjacent valley lands. These towering soil losses not only damage contiguous lands and render the highways unsightly, but they also have a direct influence on road-maintenance costs, inasmuch as the eroded materials must periodically be removed from culverts and roadside ditches to maintain proper drainage, or must be replaced by hauling and filling for roadbed upkeep. Station studies indicate that fixation measures will reduce these soil losses to a very small quantity within a few weeks after control is begun. If the plant cover is properly established and maintained, future operations can probably be limited to the occasional replacement of surfacing material and rather infrequent grading of berms and drainage ditches.

Cooperating Bureaus

Birds interfere with direct seeding of longleaf pine.

That direct seeding of longleaf pine in years when there is a good cone crop is impracticable, regardless of site or the season of planting, is borne out by sample plots established on the Harrison Experimental Forest in south Mississippi. Whether on recent burns, 1-year "roughs," or 2-year "roughs," the results were the same: almost no seed remained uneaten by birds to germinate and restock the planted areas. The same was true regardless of the time of planting; seed sown in early November showed as little survival in the course of several months as that planted in late December. In southern Mississippi the longleaf seed crop produced in the fall of 1940 was light in comparison with that of other years, but sufficient in volume to justify the continuation of this study. Birds appeared in normal numbers, and longleaf pine seed was again the preferred food of the roving flocks of blackbirds and meadowlarks.

Carbon disulfide controls Texas leaf-cutting ant in forest plantations.

The Texas leaf-cutting ant, an insect often killing young pine trees on reforestation areas in Louisiana and Texas soon after planting, is being successfully controlled by pouring carbon disulfide into ant holes just before planting the trees. Besides the carbon disulfide, 14 additional chemicals are being tested on the Kisatchie National Forest in cooperation with the local Forest Service staff to discover a safer chemical treatment. Use of several of these chemicals appears feasible.

Powder-post beetles are controlled by chemical dips.

Lyctus powder-post beetles destroy large quantities of hardwood lumber and other forest products. Studies looking toward the control of these beetles have demonstrated that the life cycle may be as short as 3 months. A paper on the biology of two species of Lyctus beetles has been prepared.[4] Chemical dips of borax or microfine wettable sulfur solutions are being used on a commercial scale for the prevention of attack by these beetles.

Spray treatments reduce Cronartium rust on slash pine seedlings.

At the W. W. Ashe Nursery, Brooklyn, Miss., a number of spray combinations were tried out to control fusiform rust (Cronartium fusiforme) infection on slash pine seedlings. Of the various combinations tried, including spray materials and adhesives, Bordeaux mixture, 8-8-100, with 1 pint of Santomerse S (salt of a substituted aromatic sulfonic acid, in aqueous solution) gave the most effective and consistent results of the combinations tried, reducing infection from 13 percent in unsprayed plots to 1.0 percent in the sprayed. Other combinations tried, in order of effectiveness, were Bordeaux mixture with an emulsion of raw linseed oil and fish oil soap, Bordeaux mixture with casein spreader, Copper Hydro with Santomerse, dry lime sulfur with Santomerse and dry lime sulfur with casein spreader. Lime sulfur was the least effective, but it should be pointed out that liquid lime sulfur may be more effective than the dry form.

---

[4] Part I published in Louisiana Conservation Review, Winter, 1940-41. Part II to appear in Spring issue.

Observations indicate that the number and frequency of sprayings necessary for effective control will vary from year to year depending on seasonal development of the alternate host (oaks) and weather conditions. The first spray was applied when the first uredia of the disease appeared on the oak leaves in the vicinity of the nursery, and before telia developed or immediately following the removal of burlap. The frequency of spraying was varied in the tests, the most effective spray schedule being two sprayings twice-a-week for the first 4 weeks and then reduced to one-a-week for the next 4 weeks. All spraying was stopped on June 3, as field observations indicated that the peak of sporidia production was past. In one spray series, eight sprayings reduced cankered seedlings to 2.7 percent. It is anticipated that control can be effected by six to eight sprayings if properly timed and applied.

Green lumber is protected from ambrosia beetle attacks by chemical sprays.

Experiments extending over 30 years have until recently been unsuccessful in developing dips or sprays to prevent ambrosia beetle attack in green logs and lumber, especially hardwoods. Recently sprays of dichlorodiphenyloxide and several other chemicals have apparently been successful for a reasonable time in protecting lumber from attack by these beetles. Green lumber can be safeguarded by end-racking for periods as long as 15 days before placing in flat piles. This end-racking reduces the surface moisture to approximately 50 percent—below the point where the beetles find the wood attractive. Studies of the ambrosia beetle have shown that the complete life cycle takes only a few weeks. Some of the fungi cultivated by these beetles are being described by Dr. A. F. Verrall of the Bureau of Plant Industry.

Soil poisons for termites effectively supplement structural insulation.

Three years after treatment, inspections of the termite-infested buildings treated by the chemical insulation method indicate that in general such soil poisons are worthless unless structural repairs or changes, such as the removal of all wood in contact with the ground and the pointing up of poor mortar in foundations, are also put into effect. Where there is poor mortar in foundations and the termites are gaining entrance through the interior, it is also necessary to drill and treat the foundations with chemicals. However, soil poisons are a successful supplement to structural control.

Surveys show importance of decay in buildings.

During 1940 a study of decay of wood in buildings was initiated as a major project. Preliminary surveys show that the problem is of importance in the South. In most cases serious decay could be traced to improper use of wood and not to unsuitability of wood for use in buildings. Construction practices found contributing to serious decay are (1) the use of dirt-filled porches without protecting the sill behind the fill, (2) the use of untreated wood of low decay resistance in contact with moist concrete or soil, (3) the use of wood of low decay resistance for exterior steps, rails, porch floors, etc., and (4) wood debris under buildings. Other practices aggravating those mentioned or in some cases alone responsible for decay are (1) inadequate ventilation of the substructure, (2) rain seepage into open joints in exterior woodwork, and (3) leaks in roofs and plumbing. Control measures apparently are not generally understood by builders, architects, and house owners. Emphasis is being placed on the study of proper building design and construction as measures for decay protection. Urgently needed is development of control measures which will be convenient to use and low in cost, so that they will be generally adopted. Unless such simple control measures can be specified, further use of wood substitutes in buildings is to be expected.

Plans for 1941

Forest Management

The current program of forest management research will be continued, with emphasis again placed upon the development of experimental forests.

In the field of silviculture, research on bottomland hardwoods will continue to receive principal attention. Stand improvement and regeneration studies on the Delta Experimental Forest at Stoneville, Miss., will be continued. Studies of natural regeneration and of the effect of plant hormones on the rooting of cottonwood cuttings will be commenced.

In the field of pine silviculture, principal attention will be given to the review and summary of all available information on the management and silviculture of longleaf pine, and the development of comprehensive management plans for the Olustee and Harrison Experimental Forests. Remeasurements and other field work on miscellaneous thinning, pruning, stand improvement, and methods-of-cutting studies will be handled according to schedule. A study of the survival and growth of the abundant shortleaf and loblolly pine reproduction resulting from the bumper 1939 seed crop at Crossett, Ark., will be started. The object will be to determine the effects of different conditions of seedbed, ground cover, and stand density on growth and survival.

In the field of silvics, laboratory data on the nutritional requirements of slash pine will be analyzed, and experiments on stimulation of the height growth of longleaf pine seedlings will be continued.

Main emphasis in the field of mensuration will be placed on the preparation of a problem analysis. The manual on volume tables, and also the manuscript on "Sampling methods applicable to forestry and range work," being prepared in collaboration with Professor F. X. Schumacher of the Duke School of Forestry, will be completed in 1941.

In the field of naval stores, it is planned (1) to continue the study of stimulation of gum flow by application of chemicals; (2) to continue the study of gum yields as affected by different face widths, and (3) to complete a report on yields from advance streaking and from various specifications for chipping of vigorous young slash pine.

In the field of fire main attention will be given to the study of fire effects, continuing present studies and analyzing available data. A report on the influence of fires upon the establishment and survival of longleaf pine seedlings will be prepared. A study of the effect of fire and methods of cutting upon reproduction and growth of pine in the shortleaf-loblolly-hardwoods type will be established. Work in fire control will be confined to checks of the fire-danger meters in use, in cooperation with Region 8. Work in fire behavior will consist of reanalysis of existing data to improve present mechanisms for estimation of rate of spread.

In the field of regeneration, current investigations will be continued and reports on seed studies will be completed.

Forest Economics

Investigations of the financial aspects of private forestry in the shortleaf and loblolly pine region will include a number of distinct activities. The study of what constitutes a marginal sawlog under different market conditions will be continued. The economic advantages of using tree and log grades in timber inventories and sales will be inquired into. It is planned to continue the investigation of present and future road requirements for areas of second-growth timber that are being cut selectively. The cutting program in the study of the effect of 1-, 3-, 6-, and 9-year cutting cycles upon costs and returns from the management of typical second-growth stands on the Crossett Experimental Forest, Crossett, Ark., will be carried forward. Efforts will be made to determine what effect various degrees of opening up stands by cutting have had upon growth and development of the reserved stands.

Another study will examine the effect of increases in labor and other costs upon the utilization practices of sawmills, pulp mills, and other timber owning and operating companies. Compilation of all available data bearing on the financial aspects of private forestry will proceed; this information will be used in setting up estimates of the financial results to be expected from the application of different forestry methods to typical properties in the shortleaf-loblolly region. A comprehensive report entitled "Financial aspects of selective cutting in second-growth shortleaf and loblolly pine," covering the results of several years' study at Crossett, will be submitted for publication.

The report for Washington Parish, La., in the study of farm woodlands, will be revised and issued as an Occasional Paper. A similar report for Hempstead County, Ark., will be issued as an Occasional Paper.

A progress report based upon the initial study of factors influencing private land management, which was confined principally to lumber companies, will be completed. The next step proposed is to develop a working plan covering similar studies for other forest-land ownership groups.

In the investigation of forest taxation and tax delinquency in the Lower South, it is planned to complete the tax-index study in Choctaw and Jackson Counties, Ala., and publish a report for that state, covering nine counties. The same kind of study will be commenced in Louisiana, the sample parishes to be selected in collaboration with the State Forester. Data on 1940 taxes in Mississippi will be obtained, in cooperation with the Regional Office of the United States Forest Service.

Forest Survey

Carrying on the program of reports, comprehensive Survey releases for the last two survey units—north Mississippi and Mississippi Delta—will be completed. The drafts of state reports for Alabama, Florida, and Mississippi will be completed, and the state reports for Louisiana and Georgia will be revised. Assembling of data and preparation of the regional report for the Lower South will continue. In the early part of 1941, U. S. D. A. Miscellaneous Publication No. 390, "Forest Resources of South Georgia," is to be ready for distribution.

In the work of keeping the Survey up to date, lumber production forms for the 1940 Census of Manufactures will be edited for eight states: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, and Texas, and a field canvass of the delinquent mills in these states will be made. This work is done in cooperation with the Bureau of the Census. Compilation of statistics on forest drain for 31 survey units through 1939 is to be completed. Naval stores compilations and estimates for the 1939-40 season will be concluded, and those for 1940-41 season begun.

Estimates of current growth and mortality for 31 survey units through 1939 will be finished and the change in growing stock in each of these units will be determined.

In the further analysis of Survey data, it is planned to continue compilation and analysis of Survey data with the purpose of determining and locating subregions of forestry practice throughout the Lower South. This will include the preparation of several maps showing subregions having common characteristics, such as ownership status of forest land, site quality, industrial development, markets, different degrees of intensity of use, species, types, stocking, etc. Scheduled to be finished are the compilations of county forest acreages from Survey and Census records, and of saw-timber and cordwood volumes for forest and county acres by counties. Recent Census of Population figures will be correlated with forest area by counties. Reanalysis of Survey sampling errors is to be initiated.

Extension of the Survey to additional areas might well be furthered by an extensive survey in cooperation with the state forest services concerned of the post oak and cedar-brake regions in Texas and Oklahoma not already covered, and either a line-plot or an extensive survey of the timber resources of northwest Arkansas. If funds are available, a line-plot survey will be made. Otherwise it may be possible to work out a cooperative survey of extensive nature with the state forest services.

Cooperation, with respect to the Appalachian Forest Survey, includes completing the punching and tabulation for the three survey units now under way and for the two additional units in Virginia already surveyed. Other cooperative work to be continued will require special resource statements and similar reports based on Survey data for interested agencies, such as regional offices of the National Resources Planning Board, state planning boards, state forestry organizations, the Regional Office of the United States Forest Service at Atlanta, railroads, prospective industrial investors, etc.

Forest Influences

Major effort during 1941 will be devoted to furnishing the Forest Service and other agencies with technical advice and guidance on roadbank-stabilization and other erosion-control problems. This will be largely accomplished by reporting results from the investigations at Holly Springs and the Irons Fork Experimental Forest in a form suitable for publication and with emphasis on practical methods of carrying on corrective work in erosion control; direct advice and assistance will also be furnished operations projects, particularly with respect to problems in the Ouachita Mountain region of Arkansas, where investigations are new and only exploratory studies have been made. Current investigations will be continued to reinforce previous findings and to permit further refinement of techniques.

To the extent possible, methods in gully control that have been developed at Holly Springs during the past 10 years will be summarized, and, if opportunity is afforded, a regional survey will be made to appraise current erosion-control practices as they apply to forest and wild lands in the extensive Gulf Coastal Plain region. The purpose of this is to gage the applicability of the Holly Springs methods to allied problems in other parts of the Station's territory with a view to prescribing regional techniques and standards.

On the Irons Fork Experimental Forest the most important task of the year will be to complete a comprehensive analysis of forest-influences problems in the Ouachita Mountains and contiguous Arkansas Valley area to serve as a guide for future investigations. Subsidiary jobs include: The installation of at least one permanent stream-gaging station, analysis of 4 years' records from run-off plots, inauguration of forest-cover changes on experimental plots, and the establishment of additional roadbank-stabilization trials.

Flood-Control Surveys

The Station's 1941 schedule for flood-control surveys investigations includes the following activities and objectives: (1) Bring the revision of the Little Tallahatchie report to a conclusive status by formulating a remedial flood-control program and evaluating its costs and benefits; (2) complete Forest Service phases of several current surveys, including the Lower Arkansas, Grand (Neosho) (Ark., Okla., Mo., and Kans.), and Middle Colorado (Tex.) River projects; (3) carry forward to about 75 percent completion surveys of the Yazoo and Upper White watersheds; and (4) participate in preliminary examinations of the Tombigbee, Big Black, Altamaha, Upper Red, Mermentau, San Jacinto, and Brazos Rivers.

Cooperating Bureaus

Bureau of Plant Industry

The work with the canker-forming rusts is to be continued, extending the investigation to include (1) studies of environmental factors associated with infection of pine, and (2) surveys of the rust hazard for different localities as influenced by forest type and relative abundance of oaks. The study of decay of wood in buildings will be continued.

Forest Entomology

Additional experiments will be conducted to discover safer fumigants for the control of the Texas leaf-cutting ant. Pyrethrum and derris solutions in petroleum oil will be tested for the control of white grubs in forest nurseries. New chemical sprays for the control of ambrosia beetles will be tried and testing on a commercial scale of those found effective during 1940 will be continued. Various combinations of chemical dips already found effective in the control of *Lyctus* powder-post beetles with chemical dips found effective in preventing sap stain will be tried out. Tests of additional chemical soil poisons and preservatives for the control of termites attacking wood, plywood, and fiberboard will be made, but in the case of soil poisons a dilute toxic emulsion, which is so cheap that it can be used in large quantities, will be tested, particularly for use in soils on wet sites. This emulsion includes pentachlorphenol, trichlorbenzene, and arsenic, or sulfur; the sulfur is to be substituted for arsenic where there is valuable vegetation near the foundation. Special efforts will be made to continue to be helpful in the national defense program, as in giving advice on how to prevent and remedy damage by termites to old or new construction and damage by powder-post beetles to stored blanks, implement handles, and wooden wheels.

Fish and Wildlife Service

Studies of bird and rodent damage to longleaf pine reproduction will be continued in areas where there is a sufficient seed crop to justify this research in the field. Florida and Georgia will be given preference if conditions warrant it.

Experimental Forests Operated by the Southern Forest Experiment Station

Name	Headquarters	Area (acres)
Chewalla	Holly Springs, Miss.	2,500
Crossett	Crossett, Ark.	1,686
Delta*	Stoneville, Miss.	2,580
Harrison	Saucier, Miss.	5,060
Hitchiti	Round Oak, Ga.	4,735
Irons Fork	Mena, Ark.	8,978
Olustee	Olustee, Fla.	2,961
Palustris	Pollock, La.	4,100
San Jacinto	Huntsville, Tex.	2,150

---

*Operated in cooperation with the Mississippi Agricultural Experiment Station.

PERSONNEL

SOUTHERN FOREST EXPERIMENT STATION

Jan. 1, 1940 - Dec. 31, 1940

ADMINISTRATION

E. L. Demmon	Director
Oran L. Raber (deceased 2/29/40)	Conservationist
John A. Lubbe	Jr. Adminis. Officer
Robert T. Hall (trans. from Dept. of State 6/20/40)	Assoc. Editor
Vera S. Lind	Sr. Clerk
Agnes G. Terburg	Sr. Clerk-Stenog.
Marie M. Flad	Clerk-Stenog.
Charles H. Langhoff, Jr	Asst. Clerk
John E. Lau	Asst. Clerk-Stenog.
Helen Schweitzer	Asst. Clerk-Stenog.
Norma Wooddy	Sr. Stenog.
Ventura J. Houpy	Jr. Multilith Opr.
Lillian E. Roane	Jr. Clerk-Typist
Iretta C. Austin (trans. to Custodial Service 8/18/40)	Telephone Operator
Floyd F. Terranova (E.O.D. 2/16/40)	Asst. Messenger

FOREST MANAGEMENT

John R. Curry	Prin. Silviculturist
Henry Bull	Silviculturist
Philip C. Wakeley	Silviculturist
William G. Wahlenberg	Forester
C. Allen Bickford	Assoc. Silviculturist
Roy A. Chapman	Assoc. Silviculturist
Theodore A. Liefeld	Assoc. Silviculturist
Lloyd F. Smith (E.O.D. 10/14/40)	Assoc. Silviculturist
Louis J. Pessin	Assoc. For. Ecologist
John A. Putnam (E.O.D. 2/16/40)	Assoc. Forester
Paul A. Swarthout (trans. from Osceola N.F. 5/1/40)	Assoc. Forester
Peter J. Ceremello (trans. from Kisatchie N.F. 3/1/40)	Asst. Silviculturist
David Bruce (furl. for military duty 12/16/40)	Jr. Forester
*Philip N. Knorr (E.O.D. 12/2/40)	Jr. Forester (CCC)
Herbert H. Muntz (assigned from Region 8)	Jr. Forester (CCC)
*Earl L. Stone, Jr. (trans. from Fire Pro. 12/1/40)	Jr. Forester
*Mary L. Nelson (resigned 4/30/40)	Jr. Plant Physiol. (CCC)
Arthur L. Shepard	Asst. to Tech.
*Richard C. Smith (resigned 1/30/40)	Asst. to Tech.
*John E. Granson (1/19/40 - 6/30/40)	Asst. Field Asst. (CCC)
*Charles E. Hardy (1/20/40 - 6/1/40)	Asst. Field Asst. (CCC)

FOREST MANAGEMENT—Cont.

*Tommy T. Kohara (1/1/40 - 5/17/40; 6/17/40 - 6/30/40)	Under Field Asst. (CCC)
Robert L. Brooks	Minor Asst. to Tech.
Charles D. DeShazor	Minor Asst. to Tech. (CCC)
Henry W. Hughes (furl. 12/17/40)	Minor Asst. to Tech. (CCC)
Jack B. Pearson (resigned 9/27/40)	Minor Asst. to Tech. (CCC)
Norman M. Scarbrough	Minor Asst. to Tech. (CCC)
Elizabeth Bergland	Clerk-Stenog.
Clark H. Streetman	Clerk
Mary R. Craig (L.W.O.P. 10/1/40 - 12/31/40)	Asst. Clerk
William G. O'Regan (L.W.O.P. 8/10/40 - 11/18/40)	Asst. Stat. Clerk

FOREST INFLUENCES

H. G. Meginnis	Sr. Silviculturist
Norman E. Hawes	Assoc. Forester
*Ronald A. Hickey	Jr. Eng. Aid (CCC)
*Edwin R. Ferguson	Jr. Field Asst. (CCC)
John R. Gammage	Minor Asst. to Tech. (CCC)
Hubert W. Gray	Minor Asst. to Tech. (CCC)
Harold R. Johnson	Minor Asst. to Tech. (CCC)
*Charles C. Lynn (trans. to Miss. N.F. 10/1/40)	Under Agri. Aid (CCC)

FOREST SURVEY

Inman F. Eldredge	Prin. For. Econ.
Frank A. Ineson	Sr. For. Econ.
Philip R. Wheeler	For. Econ.
George B. Ward, Jr. (trans. to Ouachita N.F. 2/16/40)	Jr. Forester
Harry F. Smith	Asst. For. Econ.
William S. Stover	Asst. For. Econ.
Virgil B. Davis	Asst. Forester
Robert D. Andrews	Sr. Eng. Draftsman, Civil
Camelia M. Larsen	Clerk
Martha E. Nelson	Clerk
Lucille P. Olsen (reinstated 12/2/40)	Stat. Clerk
Honora W. Cassens	Sr. Tab. Equip. Opr.
M. Madeleine Archinard	Asst. Clerk-Stenog.
Elmire A. Even (resigned 5/8/40)	Asst. Stat. Clerk
Earline C. Taylor	Jr. Clerk-Stenog.
Una M. Zaffers (E.O.D. 10/16/40)	Under Card-Punch Opr.

FOREST ECONOMICS

Inman F. Eldredge	Prin. For. Econ.
Walter E. Bond	Sr. For. Econ.

FOREST ECONOMICS—Cont.

Russell R. Reynolds	For. Econ.
Ronald B. Craig	Assoc. For. Econ.
Edmund T. Hawes (detailed from R-8 State & Priv.For. 3/20/40 - 6/30/40)	Assoc. Forester
Ike W. Rawls	Asst. to Tech.
*E. Holger Wahlsteen (S.S.T. 3/22/40)	Field Asst.
Arthur W. Nelson, Jr. (5/1/40 - 6/30/40)	Agricultural Aid
Ashley G. Williams	Under Agricultural Aid
G. W. Turner, Jr	Jr. Clerk-Stenog.

FLOOD-CONTROL SURVEYS

H. G. Meginnis	Sr. Silviculturist
William A. Kelly (detailed from Cen. States For. Expt. Sta. 1/1/40 - 2/15/40)	Sr. Hydraulic Eng.
Mark M. Lehrbas	Silviculturist
Douglas Basnett	Forester
Carl F. Olsen (furl. for military duty 11/3/40)	Forester
George K. Stephenson (trans. from Ala. N.F. 2/1/40)	Forester
Lewis M. Turner (trans. to WO 6/16/40)	Forester
Harry M. Cortright	Assoc. Hydraulic Eng.
James H. Foster (trans. from Cen. States For. Expt. Sta. 3/30/40)	Assoc. Hydraulic Eng.
Eugene W. Gemmer (trans. from Man. 1/16/40)	Assoc. Silviculturist
Kenneth L. Roberts (trans. from N.E. For. Expt. Sta. 5/23/40)	Assoc. Conservationist
Edsko J. Dyksterhuis	Assoc. Range Examiner
Elon H. Bomberger	Assoc. Forester
D. Manley Knight (trans. from Cen. States For. Expt. Sta. 3/1/40)	Assoc. Forester
James B. Ringwood (trans. from Lake States For. Expt. Sta. 8/1/40)	Asst. Hydrologist
Martin E. Baudendistel	Asst. Forester
John F. Kellogg	Asst. Forester
Walton R. Smith	Asst. Forester
Albert K. Thurmond, Jr	Asst. Forester
Robert M. Short (7/22/40 - 9/21/40)	Jr. Hydraulic Eng.
John L. Arend	Jr. Forester
Lowell F. Baker	Jr. Forester
Kenneth A. Brinkman (trans. from Cen. States For. Expt. Sta. 3/1/40; trans. to S.W. Expt. Sta. 12/1/40)	Jr. Forester
Keith W. Dorman (trans. from Lake States For. Expt. Sta. 4/9/40)	Jr. Forester
Donald P. Duncan (trans. from Prairie States For. Proj. 12/28/40)	Jr. Forester
Herman D. Grafman (trans. from NETSA 5/6/40)	Jr. Forester

FLOOD-CONTROL SURVEYS—Cont.

John J. Kerst	Jr. Forester
William F. Mann, Jr. (trans. from NETSA 5/1/40)	Jr. Forester
Robert D. McCulley (trans. from Prairie States For. Proj. 12/28/40)	Jr. Forester
Truman E. Pease	Jr. Forester
Lee S. Settel	Jr. Forester
A. Glenn Spears (trans. from Cen. States For. Expt. Sta. 4/1/40)	Jr. Forester
Sidney Weitzman (trans. from NETSA 1/11/40)	Jr. Forester
James G. Rowbury (trans. from Cal. For. Expt. Sta. 7/1/40)	Jr. Range Examiner
Earl N. Jones (trans. from Rocky Mt. For. Expt. Sta. 9/16/40)	Field Asst.
Irvin L. Sealander (trans. from Rocky Mt. For. Expt. Sta. 9/16/40)	Under Field Asst.
Ben A. Scarbrough (E.O.D. 9/16/40)	Jr. Civil Eng.
Carl E. Schneider (trans. from Soil Cons. Serv. 12/10/40)	Jr. Agricultural Eng.
Charles N. Phelps (detailed from Cherokee N.F. 7/25/40 - 10/25/40)	Sr. Engineering Aid
J. Wayne Higdon (trans. from Nantahala N.F. 6/16/40)	Engineering Aid
William H. Cone, Jr. (trans. from Chattahoochee N.F. 7/1/40)	Eng. Draftsman
Harold C. Kaelin (trans. from Cen. States For. Expt. Sta. 1/16/40)	Eng. Draftsman
Lester E. Carstens (resigned 3/6/40)	Asst. Eng. Draftsman
William T. Neely (E.O.D. 10/12/40)	Asst. Eng. Draftsman
Joseph S. Atkins (E.O.D. 9/16/40)	Under Eng. Aid
James A. Beard (E.O.D. 9/16/40)	Under Eng. Aid
Harry B. Bratton (E.O.D. 8/22/40)	Under Eng. Aid
Robert L. Eden (E.O.D. 12/9/40)	Under Eng. Aid
Canady H. Lockhart (7/22/40 - 8/21/40; 9/16/40 - 10/18/40)	Under Eng. Aid
Joseph D. Lowe (E.O.D. 9/16/40)	Under Eng. Aid
William T. McBroom (E.O.D. 8/22/40)	Under Eng. Aid
Earl J. Pilcher (E.O.D. 9/16/40)	Under Eng. Aid
Victor Pilcher (E.O.D. 9/16/40)	Under Eng. Aid
Roland E. Ragland (9/16/40 - 12/15/40)	Under Eng. Aid
John K. Thomas (E.O.D. 12/9/40)	Under Eng. Aid
Herbert L. Daniels	Clerk
George E. Clayton (trans. from Cen. States For. Expt. Sta. 4/1/40)	Clerk
Ruth Marshall	Asst. Clerk-Stenog.
Hazel B. Rothenheber (trans. from Cen. States For. Expt. Sta. 1/25/40)	Asst. Clerk-Stenog.
Bertha H. Schneider	Asst. Clerk-Stenog.
Sidney S. Boone (E.O.D. 9/16/40)	Jr. Clerk-Stenog.
Isabell L. Nelson	Jr. Clerk-Stenog.
Allen M. Byrd	Jr. Cal. Mach. Opr.

FLOOD-CONTROL SURVEYS—Cont.

James A. Hazelton (E.O.D. 5/16/40)	Jr. Cal. Mach. Opr.
Ray B. Smith (E.O.D. 10/21/40)	Jr. Cal. Mach. Opr.

Staff of Cooperating Federal Bureaus

BUREAU OF PLANT INDUSTRY

P. V. Siggers	Assoc. Pathologist
A. F. Verrall	Asst. Pathologist
Bailey Sleeth	Asst. Pathologist
Howard Lamb (trans. to Columbus, Ohio 3/2/40)	Asst. Conservationist

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

T. E. Snyder	Sr. Entomologist
H. R. Johnston	Asst. Entomologist
Ruth E. Wood (L.W.O.P. 2/13/40 - 12/31/40)	Asst. Clerk-Stenog.

FISH AND WILDLIFE SERVICE

Thomas D. Burleigh	Assoc. Biologist

---

*Informal appointments.

PUBLICATIONS

Jan. 1, 1940 - Dec. 31, 1940

Bickford, C. A., and Bruce, David	Fire-discovery time in the longleaf-slash pine type. Conservationist 6 (11): 14, 18. March 1940. Southern Pulp and Paper Journal. 3 (1): 16, 18, illus. June 1940.
Bond, W. E.	Costs and returns of managing 100,000 acres of shortleaf and loblolly pine for sustained yield. Allgemeine Forst-und Jagd-Zeitung 116 (10): 237-246. Oct. 1940. In German. Translation by Arthur O. Weidelich.
————	Dollars-and-cents control in forest management. Southern Lumberman 161 (2033): 193-196, illus. Dec. 15, 1940.
Bull, Henry, and Putnam, J. A.	Early survival of cottonwood and hybrid poplar plantations at Stoneville, Miss. Occasional Paper No. 94. Southern Forest Expt. Sta. 7 pp. Oct. 4, 1940.
Burleigh, Thomas D., and Lowery, George H., Jr.	Birds of the Guadalupe Mountain Region of western Texas. La. State University. Occasional Papers of the Museum of Zoology. 8: 85-151, illus. Aug. 20. 1940.
————	Brewer's blackbird in Florida. The Auk 57 (4): 574-575. Oct. 1940.
Burleigh, Thomas D., and Sutton, George Miksch	Birds of Las Vigas, Veracruz. The Auk 57: 234-243. April 1940.
————	Birds of Tamazunchale, San Luis Potosi. The Wilson Bulletin 52 (4): 221-233. Dec. 1940.
————	Birds of Valles, San Luis Potosi, Mexico. The Condor 42 (5): 259-262. Sept. - Oct. 1940.
————	A new tufted flycatcher from Hidalgo. The Wilson Bulletin 52 (1): 30-31. March 1940.
————	A new warbling Vireo from Hidalgo. The Auk 57: 398-400. July 1940.
Christian, M. B.	Lyctus beetle damage prevention. Southern Lumberman 160 (2021): 47-49, illus. June 15, 1940.

Christian, M. B.	Lyctus powder-post beetles and their control. Pests 8 (6): 8-9, 10, illus. June 1940.
Collet, M. H.	A calibrated beam for use in gaging small streams. Jour. Forestry 38 (1): 66-68, illus. Jan. 1940.
Craig, Ronald B.	The forest tax delinquency problem in the South. Occasional Paper No. 92. Southern Forest Expt. Sta. 14 pp. June 20, 1940.
————	Taxes on forest property in five selected counties in Mississippi, 1936 - 1939. Occasional Paper No. 89. Southern Forest Expt. Sta. 9 pp. April 5, 1940.
————	Taxes on forest property in two selected counties in Mississippi, 1936 - 1939, with state averages. Occasional Paper No. 89 (Supplement). Southern Forest Expt. Sta. 3 pp. June 5, 1940.
Cruikshank, James W.	Forest resources in the Tennessee Valley of north Alabama. Forest Survey Release No. 49. Southern Forest Expt. Sta. 39 pp. March 29, 1940.
————	Forest resources of north central Alabama. Forest Survey Release No. 50. Southern Forest Expt. Sta. 36 pp. Sept. 30, 1940.
————	The utilization of dogwood in the Lower South. Jour. Forestry 38 (3): 284-285. March 1940.
Davis, V. B.	A cursory survey of the forest resource of the East Texas post oak belt. Forest Survey Release No. 52. Southern Forest Expt. Sta. 9 pp. Dec. 30, 1940.
Demmon, E. L.	The contributions of forestry under changing conditions in southern agriculture. (Address delivered before the Agronomy Sec. of the 41st Ann. Convention of Assn. of Sou. Agri. Workers, Birmingham, Ala., Feb. 8, 1940.) Conservationist 6 (12): 12-13, 16. April 1940. Proc. 41st Ann. Convention of Assn. of Sou. Agri. Workers, Feb. 7-9, 1940. Abstract on pp. 72-73.
————	Forest research and the southern lumber industry. (Address delivered before the 25th Ann. Meeting of the Southern Pine Assn. in New Orleans, La., March 28, 1940.) Occasional Paper No. 90. Southern Forest Expt. Sta. 7 pp. April 18, 1940. Excerpts: Southern Pine Forestry Notes 68. 1 page. May 1940.

Demmon, E. L.	Oklahoma's forest resources. Oklahoma Farm Chemurgic Conference at Tulsa, Okla., Nov. 23, 1940. Mimeographed by the National Farm Chemurgic Council, Columbus, Ohio, for limited distribution.
Eldredge, I. F.	A forester reviews the parade. Southern Lumberman 161 (2033): 106-109, illus. Dec. 15, 1940.
—————	Hardwoods offer South industrial opportunity. The Southern Lumber Journal 44 (10): 26, 28. Oct. 10, 1940.
—————	The hardwoods of the South. The South's Resources. Manufacturers Record. pp. 41-43, illus. Sept. 1940.
Gemmer, E. W., Maki, T. E., and Chapman, R. A.	Ecological aspects of longleaf pine regeneration in south Mississippi. Ecological Monographs 21 (1): 75-86. Jan. 1940.
Huberman, M. A.	Normal growth and development of southern pine seedlings in the nursery. Ecology 21 (3): 323-334, illus. July 1940.
—————	Studies in raising southern pine nursery seedlings. Jour. Forestry 38 (4): 341-345. April 1940.
Hunt, George M., and Snyder, T. E.	An international termite exposure test - Eleventh progress report. 36th Ann. Meeting of the American Wood-Preservers' Assn., St. Louis, Mo., Jan. 23 - 25, 1940.
Lamb, Howard, and Sleeth, Bailey	Distribution and suggested control measures for the southern pine Fusiform rust. Occasional Paper No. 91. Southern Forest Expt. Sta. 5 pp. May 8, 1940.
Liefeld, T. A.	Evolution in the gum naval stores industry and forestry. Gamble's International Naval Stores Year Book for 1940-41. Pages 127-128. 1940.
—————	Increased naval stores production from chemically treated streaks. Occasional Paper No. 97. Southern Forest Expt. Sta. 6 pp. Nov. 8, 1940. The AT-FA Journal 3 (3): 4, 12. Dec. 1940. Illustrations in Jan. 1941 issue.
—————	Naval stores yields from planted slash pine in middle Georgia. The AT-FA Journal 3 (2): 6, 11. Nov. 1940. Naval Stores Rev. 50 (33): 8, 10. Nov. 16, 1940.

Liefeld, T. A.	What can we do about the weather? Naval Stores Rev. 50 (31): 10. Nov. 2, 1940. Published under title: What we can do about weather is a question that interests all. The AT-FA Journal 3 (2): 4. Nov. 1940.
Meginnis, H. G.	Effect of top pruning on survival and early growth of black locust. Jour. Forestry 38 (1): 30-36. Jan. 1940.
Nelson, Mary L.	Successful storage of southern pine seed for seven years. Jour. Forestry 38 (5): 443-444. May 1940.
Putnam, J. A., and Bull, Henry	Improvement cuttings in the bottomland hardwood forests of Mississippi. Occasional Paper No. 93. Southern Forest Expt. Sta. 14 pp. Oct. 22, 1940. Southern Lumberman 161 (2033): 203-207. Dec. 15, 1940.
Reynolds, R. R.	A guide to the Crossett Experimental Forest in Arkansas. Southern Forest Expt. Sta. 27 pp., illus. 1940.
————	Lightning as a cause of timber mortality. Service Bulletin 24 (4): 7. Feb. 19, 1940.
————	Pulpwood and log production costs as affected by type of road. Occasional Paper No. 96. Southern Forest Expt. Sta. 11 pp. Oct. 14, 1940. Published under title: "Log and pulpwood production costs as affected by type of road." Southern Lumberman 161 (2033): 162-165, illus. Dec. 15, 1940. Jour. Forestry 38 (12): 925-931. Dec. 1940.
Reynolds, R. R. and Bruce, David	Check of Central States fire danger meter. Fire Control Notes 4 (2): 77-79. April 1940.
Shepard, A. L.	Another use for pine needles. Service Bulletin 24 (17): 5. Aug. 19, 1940.
Siggers, Paul V., and Doak, K. D.	The little-leaf disease of shortleaf pines. Occasional Paper No. 95. Southern Forest Expt. Sta. 5 pp., illus. Oct. 9, 1940.
Smith, H. F.	Primary wood-products industries in the lower South. Forest Survey Release No. 51. Southern Forest Expt. Sta. 19 pp., illus. Nov. 29, 1940.

Smith, H. F.	Trends in the primary forest industries of the lower South. Southern Lumberman 161 (2033): 110-112, illus. Dec. 15, 1940.
Snyder, Thomas E.	The browning of the needles of young yellow pine trees in the Gulf States by a leaf-feeding beetle (*Colaspis pini* Barber). Southern Lumberman 160 (2020): 46, illus. June 1, 1940.
Southern Forest Experiment Station	The Irons Fork Experimental Forest. 4 pp. Jan. 1940.
———————	The Olustee Experimental Forest. 8 pp. Jan. 1940.
———————	Southern Forestry Notes Nos. 31 - 36. Jan., March, May, July, Sept., and Nov. 1940.
Spillers, A. R.	Forest resources of west central Alabama. Forest Survey Release No. 48. Southern Forest Expt. Sta. 30 pp. Jan. 12, 1940.
Stone, Earl L., Jr.	Frost rings in longleaf pine. Science 92 (2395): 478. Nov. 22, 1940.
Stover, W. S.	How timber growth and drain in the lower South are estimated by the Forest Survey. Southern Lumberman 161 (2033): 100-102, illus. Dec. 15, 1940.
———————	In twice the life of a pine. Slash Pine Cache 3: 30-33. University of Florida. Forest Club Annual. 1940.
Turner, Lewis M.	Forest-land use and the soil profile. Proc. of the Soil Sci. Soc. of America 4: 343-345. 1939.
Verrall, Arthur F.	Building decays and their control in the South. Pests 8 (3): 15-17. 1940.
Ward, George B.	Forestry literature in the South. Service Bulletin 24 (5): 1-2. March 4, 1940.
———————	State control of cutting on private forests in Sweden. Jour. Forestry 38 (1): 48-51. Jan. 1940.

UNPUBLISHED ADDRESSES

Bickford, C. A.	Fire danger rating in the coastal plains and flatwoods of the South. Southern States Cooperative Fire Control Conference of State Forest Fire Control Chiefs, Camp O'Lena, near Lake City, Fla., June 3, 1940.
———	Proposed uniform scheme of damage appraisal for state and federal organizations in Region 8. Southern States Cooperative Fire Control Conference of State Forest Fire Control Chiefs, Camp O'Lena, near Lake City, Fla., June 3, 1940.
Bomberger, E. H.	The part that natural vegetation can play in controlling floods. Assn. of Agricultural Workers, Coleman County, Tex. Dec. 2, 1940.
Curry, John R.	What forestry can mean to Mississippi in the future. Ann. meeting Mississippi Forestry Assn., Jackson, Miss., Sept. 10, 1940.
Eldredge, I. F.	Our stock in trade. Open session of the Conservation Committee, Southern Pine Assn., New Orleans, La., March 28, 1940.
Hawes, N. E.	The national forestry program. Mena Lions Club, Mena, Ark., Nov. 26, 1940.
Ineson, F. A.	The forest economy of Alabama. Alabama Acad. Sci., Birmingham Southern College, Birmingham, Ala., March 29 - 30, 1940.
Knight, D. Manley	Flood control on the St. Francis Watershed, Missouri. (Above Wappapello Dam). Winter meeting Ozark Sec., Soc. of American Foresters, Springfield, Mo., Dec. 7, 1940.
Pessin, L. J.	Ecological aspects of the longleaf pine type. New Orleans Acad. Sci., March 29, 1940.
———	Effect of mineral nutrient deficiencies on young pine seedlings. Physiological Sec. of the Assn. of Sou. Agri. Workers, Birmingham, Ala., Feb. 7, 1940.

Reynolds, R. R.	The economics of forest management. Forestry Sec. of the Arkansas Acad. Sci., Fayetteville, Ark., April 26, 1940.
————	Timber utilization on the farm. Northeast Arkansas Farm Forestry Meeting, Batesville, Ark., May 17, 1940.
Smith, Walton R.	Influence of forest cover on the water cycle. New Orleans Soc. for Plant Sci., March 12, 1940.
Stephenson, George K.	Flood control on the upper White River. Winter meeting Ozark Sec., Soc. of American Foresters, Springfield, Mo., Dec. 7, 1940.
Wakeley, Philip C.	Propagating southern pines for forest planting. Address read by Dr. L. J. Pessin at meeting of New Orleans Soc. for Plant Sci., April 16, 1940.

Note: Assistance in the preparation of these materials was furnished by the personnel of Work Projects Administration official project 165-2-64-102.

TWENTY-FIRST ANNUAL REPORT

SOUTHERN FOREST EXPERIMENT STATION

New Orleans, Louisiana

E. L. Demmon, Director

1941

U. S. Department of Agriculture
Forest Service

Contents

Page

Introduction 1

Forest management 4
    Silviculture 4
    Mensuration 5
    Fire 6
    Artificial regeneration 7
    Naval stores 8

Forest economics 10
    Farm woodlands 10
    Economics of private forestry 10
    Industrial forestry 11
    Forest taxation 11

Forest survey 12
    Forest resource situation 12
    Land use and resource planning 12

Forest influences 13

Flood control surveys 14

Cooperating bureaus 15
    Insects affecting forests and forest products 15
        (Bureau of Entomology and Plant Quarantine)
    Diseases of forests and forest products 16
        (Bureau of Plant Industry)
    Forest biology 17
        (Fish and Wildlife Service)

Publications 18

TWENTY FIRST ANNUAL REPORT
SOUTHERN FOREST EXPERIMENT STATION
1941

INTRODUCTION

As the end of 1941 finds our Nation at war, it is expedient to reappraise the research program of the Southern Forest Experiment Station in order to prepare most effectively for maximum contributions in the present emergency as well as to plan for the post-war period of readjustment. In this year's annual report, the twenty-first to be issued since the Station was established in July 1921, the Station's program is reviewed in the light of present-day needs, taking cognizance of the immediate major forest problems in the territory comprising the eight States of the Lower South, describing how forest research is aiding in their solution, and presenting tentative plans for 1942. This early in the war it is not possible to determine the special lines of work most deserving of Station efforts. It is anticipated, however, that many normal Station activities will be curtailed or postponed during 1942 in order to undertake essential work related more directly to the prosecution of the war. Some curtailments in Station program were necessitated in 1941 following retrenchments in regular and emergency funds. Some program changes also were made as a result of the demands of the national emergency.

Since forest research can contribute significant information in planning for both defense and post-war needs, the Station was called upon frequently in 1941 to assist in various aspects of the national emergency. The following illustrations indicate how the Station has assisted in this respect:

(1) The recently completed inventory of the South's forest resources was used as a basis for planning the location of new industrial plants and for locating supplies of specially needed forest products.

(2) Vegetative plant material of many kinds was collected and submitted for tests as to its value for camouflage purposes.

(3) Recommendations concerning methods of stabilizing roadbanks with vegetation were furnished to one of the largest Army camps in the South.

(4) Station personnel served on various local, State, and regional committees concerned with industrial development, agricultural defense, and post-war planning.

(5) Forest pathologists and entomologists, headquartered at the Southern Station by cooperating bureaus, furnished information to the Army and Navy in regard to protecting cantonments, housing units, and other defense building projects from termites and decay, and inspected many units during their actual construction throughout the South.

Southern forests are contributing generously to the present emergency. They are the source of immense quantities of lumber used in cantonment construction, for defense plants and housing for workers, and in the building of bridges, ships, docks, and other war necessities; they provide wood for gunstocks; wooden boxes and paper board for the crating and boxing of munitions, machinery, and other war commodities; charcoal for use in gas masks; turpentine for flame throwers and flares; resin in the manufacture of shrapnel; and cellulose for explosives. Also, wood and other forest products are now being considered as possible substitutes for much-needed war materials of which supplies are short, such as to take the place of steel in barge and ship construction, in resin barrels, etc. Because many great Army camps are located here, the South naturally has been called upon to supply a large proportion of increased defense construction requirements. Many Army camps have been carved out of southern forest areas, and training maneuvers have been centered in timbered sections.

Contributions of southern forests in the period of adjustment that will follow the present national emergency should be great, not only in meeting demands for forest products, such as materials for a great reconstruction program throughout most of the world, but also in protecting watersheds and controlling floods, providing public recreation, and for the production of livestock and wildlife. Furthermore, the all-out contributions of southern forests to the war effort will leave them in need of rehabilitation, which will provide a great opportunity for public work programs during the post-war period.

The Lower South is primarily an agricultural region, but the recent decline in cotton, the principal farm crop, has pointed to the need for diversification in agricultural enterprises, and to the opportunities for increased industrial development offered by the forest resource. Few realize that the forests of this region occupy 12 times as much land as does cotton. Full development of the South's forest potentialities will help provide permanency to many communities and industries, continuous employment of labor, more business for railroads and other utilities, a broader and more stable tax base, and an increased prosperity to the region. Not only is it important to utilize these vital forest resources efficiently in the present crisis, but of equal importance, they should be managed with special regard to the period of readjustment which will inevitably follow the war, so that they can contribute their full share in supplying an outlet for labor and industry.

To conserve properly this great natural resource for maximum value to future generations of Americans, it will be necessary to improve greatly the forest management, protection, and utilization practices of most present-day forest operations. Despite much commendable forestry progress by a growing number of progressive forest landowners and operators in the South during the past two decades, much forest exploitation and waste still continue where no conscious effort is being made to perpetuate the timber resource. This becomes more alarming with the war demanding increased production of all forest materials. Even though the emergency thoroughly justifies this increased drain on our forests, harvesting should be done with the least possible waste of the resource and with the care necessary to preserve the growing stock, which is a major capital asset essential to permanent national defense and economic security.

The adoption of minimum cutting regulations to prevent further destruction and deterioration of the forest and to safeguard adequately the public interest in the forest resource has been recommended repeatedly by the Forest Service. If and when such regulatory legislation is approved, the preparation of minimum cutting standards should be guided by the findings of such agencies as the Southern Forest Experiment Station.

The most pressing problem confronting southern forestry is that of building up the forests to full productivity. The recent survey of the South's forest resources has shown that southern forest lands are producing at less than half their potential capacity. This can be attributed in large part to wasteful and destructive cutting practices and widespread burning in the past. Although progress has been made in developing good forestry practices on the National and State forests, which constitute approximately 7 percent of the total forest area in the Lower South, and on many large and small tracts of timberland owned by progressive lumber companies, pulp mills, farmers, and others, the great majority of the South's forest land at present lacks any form of proper management.

A major factor in the prevalence of destructive cutting is the small portable sawmill, amounting to more than 90 percent of all southern sawmills and accounting for more than half of all the lumber produced in the region. Operating with little or no regard to the future of the forest, the owners of these small mills usually own no timberland, in general manufacture an inferior product, pay low wages, and buy logs at prices which offer no incentive to the growing of timber. The cut of all sawmills has been accelerated recently by emergency demands. The forest survey showed a few years ago that we were cutting our saw timber somewhat faster than it was being replaced by growth, but this excess of drain over growth now has increased even further.

Another major detriment to the forests of the South is the prevalence of forest fires. It is conceded that protection from fire is essential to proper forest management, optimum tree growth, and the preservation of watershed values, yet more than half the southern forest area lacks organized fire protection; almost one-fifth of the forests burn over each year, largely from fires set by cattlemen to improve forest range lands which they do not own.

Other facts to be taken into consideration in planning a forest research program for maximum benefit to the progress of southern forestry are the following: (1) About 10 million acres of southern forest lands have been cut and burned to such an extent that they must be planted if they are to grow timber crops within a reasonable period, whereas in the last 20 years only about half a million acres have been planted successfully; (2) markets are lacking for great quantities of low-grade forest material, for little-used tree species, and for the potential production of naval stores (wartime demands, however, have temporarily increased naval stores production); (3) in certain sections, taxes on forest land are unreasonably high, with the result that tax delinquency and default are common; (4) there is a widespread lack of appreciation of the value of conservative forestry practices, owing in part to the inadequacy of public educational and extension efforts in forestry; furthermore, much information necessary for good forestry practice, and which can best be supplied by an adequate forest research program, has not been obtained, because of insufficient support for such a program; (5) annual losses from soil erosion, silting of streams and reservoirs, and flooding are serious in many parts of the South; (6) great losses are sustained by southern forests and forest products through the ravages of insects and diseases, and other enemies.

These are but some of the important factors affecting forestry in the Lower South. The Southern Station has made a good beginning towards solving some of the problems which have arisen as a result of the above conditions. Other problems have been practically untouched by research owing to lack of facilities to study them; for example, practically no research has been done in bottom-land hardwoods, yet this type covers more than 33 million acres in the South and is the greatest potential source of hardwoods in the United States; most southern forest lands are grazed to some degree, yet no research is under way by the Station to determine effective forest range practices, integrating this use with other uses of the forest; also, many aspects of the important forest fire problem, the economics of integrated forest production, the relation of forests to run-off, soil erosion, and floods, have had the benefit of little or no research.

In the remainder of this report, research progress will be discussed in relation to important forest problems, and particularly to those of greatest current need due to the war effort.

FOREST MANAGEMENT

Silviculture

Since it is the purpose of silviculture to build up and maintain maximum forest productivity, silvicultural research is directly concerned with solving the outstanding forest problem in the Lower South. Silvicultural research covers the entire range of forest conditions, including immature and mature stands, and all degrees of stocking. A neglected or mismanaged forest is most in need of silvicultural treatment, but even a managed forest with maximum productivity must continue to be given proper silvicultural treatment if it is to continue to produce maximum yields. Six forest conditions, each of which is typical of many millions of acres of forest land in the South, are listed below, together with the Station's silvicultural studies applicable to them:

(1) Cut-over pine land supporting relatively few pines and desirable hardwoods but numerous hardwoods of no present value, such as scrub oaks. Studies of the technique, costs, and returns of improvement cuttings are applicable here, the objective being to improve the growing space for desirable trees by killing or setting back the worthless trees that interfere. The Station recently developed a cheap, effective method for killing undesirable trees with sodium arsenite put in holes made with a specially designed tool. In a study completed in 1941 it was found that, 7 years after a liberation cutting, a stand of mixed pines and hardwoods contained more than twice as many pines per acre as the adjacent, originally comparable, untreated stand. Most of the pines that were at least 3 feet high when released needed no further assistance. This type of stand is greatly in need of additional pine reproduction. Studies in central Alabama in 1941 indicated what stand conditions are required for adequate natural reproduction of pine; investigations of practicable methods of increasing pine reproduction are in progress.

(2) Cut-over bottom-land hardwood forests, containing many worthless trees of all sizes but very few trees of appreciable present or prospective value. Studies of the technique, costs, and returns of improvement cuttings apply here, just as in the pine types, but the problem is complicated by the great variety of species and the large size of many of the undesirable trees. The Station has developed marking rules for improvement cuttings in such stands, and the possibilities of marketing low-value, undesirable trees are being investigated.

(3) Sparsely stocked cut-over pine land or young old-field pine stands containing fast-growing but limby pines that are producing only low-grade, low-value material. Studies of pruning are applicable here, the objective being to determine how, when, where, and how much to prune to produce the greatest net profit through increasing wood quality. Current Station studies are providing the basis for specific recommendations.

(4) Densely stocked, even-aged stands of pine on old fields or cut-over land. Thinnings are needed here to provide adequate growing space for the best trees, and to salvage merchantable trees that would otherwise die. The Station has many thinning studies in progress, in different types and ages of stand, on different sites, and testing different methods. Analysis of several of these studies is progressing and should help in formulating specific recommendations. One of the most important thinning problems in the Lower South is in exceptionally dense young stands of slash pine in the Southeast, which have come up as a result of organized fire protection during the last decade.

(5) Advanced second-growth stands in the loblolly-shortleaf-hardwoods type, generally understocked but containing commercial volumes of merchantable saw timber, poles and piling, and pulpwood. The problem here is to make a

profitable cut while improving the stand and bringing it to maximum productivity. The Crossett Experimental Forest in southern Arkansas, where the Station is concentrating its studies of selective cutting and other management practices in the loblolly-shortleaf-hardwoods type, contains stands of this character. To be truly successful, harvest cuttings must of course result in regeneration of the stand, hence reproduction studies are also in progress at Crossett. Recent Station findings indicate the proportions of volume that may be removed selectively while insuring progress toward full productivity. At Crossett, with a growing stock of 2 M board feet per acre, for example, 8 percent of the volume may be cut every 3 years, 14 percent every 6 years, or 20 percent every 9 years; with 10 M feet per acre, 16 percent may be cut every 3 years, 30 percent every 6 years, or 41 percent every 9 years. A reproduction study established and reexamined in 1941 showed that the survival and growth of loblolly and shortleaf pine seedlings during their first full growing season were considerably better in small openings in the overhead canopy than under full overhead shade, regardless of the amount of side shade. Large openings, however, did not appear any more favorable than small openings during this early period.

(6) *Advanced second-growth stands in the longleaf-slash pine type, generally understocked but containing commercial volumes of merchantable saw timber, poles and piling, and pulpwood; and also suitable for naval stores production.* The problem here is similar to that in the shortleaf-loblolly type but is complicated by the need for integrating naval stores production with cutting. Silvicultural studies in this condition are concentrated on the Olustee Experimental Forest in northern Florida, where comprehensive tests of different methods of cutting and turpentining for creating and maintaining full productivity were begun. During 1941, turpentining and improvement cutting were the main activities on the Olustee Area, and the original experimental management plan is being revised to improve its value and facilitate its operation. A monograph on forestry in the longleaf pine type, intended to include all pertinent information now available, is also being prepared. About one-third of the manuscript was completed in rough draft in 1941 and another third was brought almost to completion.

Mensuration

Mensuration is fundamental to forestry practice and research, since it provides the basis for measuring the volume and growth of trees and stands and for conducting sound research. For the most part, adequate volume and yield tables and methods of constructing them are available but scattered through many publications and in the Station files. During 1941 the Station completed a compilation of the most important volume tables and methods of application for the Lower South, the manuscript now awaiting publication. In the field of timber growth and yield, U.S.D.A. Technical Bulletin 796, "Methods of forecasting timber growth in irregular stands," by W. G. Wahlenberg of the Station staff, was issued in December 1941. This publication describes growth-prediction methods applicable to the forest condition most commonly found in the Lower South. Growth and mortality studies on permanent sample areas are providing the basis for better forest management practices. Problems of sampling, which occur in almost every phase of forest management and forest research, were given particular attention in 1941, and a publication, "Sampling methods in forestry and range management," was prepared jointly by R. A. Chapman of the Station staff and Professor F. X. Schumacher of the Duke University School of Forestry. This manuscript will be published by the Duke University Press in 1942. In the field of statistical methods, emphasis has been given to the adaptation of statistical techniques to the design and analysis of experiments in silviculture, regeneration, naval stores production, and fire effects and control. Forest Service nurseries in the South are now using a nursery-inventory technique developed by the Station.

Fire

The widespread occurrence of forest fires is a major factor in the present understocked condition of southern forests. In no place in the world have forest fires been so numerous or so widespread. For instance, more than 80 percent of all the fires occurring in the United States are reported from the Southern States. One reason for this unusual prevalence of forest fires in the South is the old custom of annual winter burning to improve grazing and to keep the woods open. In pioneer days trees were considered of doubtful value, while grazing and hunting were dominant land uses. Considerable controversy and confusion still exist in this region as to the actual effects of forest fires upon the soil and its products. Light forest fires stimulate the growth of certain forage plants but at the same time they destroy seedlings and retard tree growth. Fire under certain circumstances may be beneficial to forest management, in the improvement of seedbed conditions, in counteracting certain tree diseases, and in reducing excessive fire hazard, but ordinarily it is harmful. Because of the widespread prevalence of woods burning in the South and the confusions and contradictions as to its possible use, a full knowledge of the actual effects of fire is of great importance.

The Station's program of fire studies includes three phases: fire behavior, effects, and silvicultural use. Studies of forest-fire behavior have been undertaken primarily to establish a basis for the development of methods of rating forest-fire danger, and have led to the preparation and adoption of a fire-danger meter for the longleaf-slash pine type. Other studies have concerned methods of improving the present fire-danger rating system. During 1941, such a study was made on a National Forest ranger district in Alabama and showed significant differences in fire-danger rating depending on the location of the instruments used in the study. This indicates the importance of properly planning the number and location of fire-danger rating stations for protected forest areas.

In the field of fire effects, where major Station emphasis is being placed, 1941 showed three definite accomplishments: (1) A series of damage appraisal tables for use on the National Forests and on State protected areas in the South were developed in cooperation with the Appalachian Station and Region 8. These tables should give more realistic and comparable appraisals of forest-fire damage throughout the South. (2) The results of 5 years of study of controlled burning on the Palustris Experimental Forest gave a basis for accurately appraising the benefits to longleaf pine reproduction of using fire in seedbed preparation, so as to obtain fully stocked longleaf pine stands. (3) Analysis of data from the Roberts Plots at Urania was completed for the 25-year period since the plots were established. This longleaf pine stand has been protected from grazing; part of it has been burned annually whereas fire has been completely excluded from the remainder. Results show that longleaf pine, once it is established, can survive annual burning, although with considerable loss in volume growth during the earlier years.

Through its fire studies, the Station aims to provide the basis for determining the value of fire protection and the possibilities of the intelligent use of fire in southern silviculture.

Artificial Regeneration

A comprehensive forest-planting program is an important part of the efforts to increase the general productivity of southern forest lands. It is estimated that at least 10 million acres of southern forest lands are so denuded of tree growth that artificial reforestation must be resorted to if these areas are to become productive within a reasonable period of time. An approximately equal area of worn-out or already abandoned cultivated land is estimated to be in need of planting to southern pine. In addition, there is a much larger acreage of forest lands with stands so thin or made up of such inferior tree species, such as scrub oak, that extensive planting operations seem desirable. Finally, under intensive forest management, planting is often more desirable than waiting many years for natural reproduction to become established.

Approximately 20 forest tree nurseries, operated principally by public agencies, are situated in the Lower South, and are producing more than 120 million trees each year. In terms of public expenditures and in public interest, the production of nursery stock ranks high among southern forestry activities. The Southern Station has conducted seed, nursery, and planting studies ever since the first years of its establishment. As a result of its findings in this field, the Station has made many worth-while contributions, particularly during the period of rapid expansion occurring in the last decade. Although carried only as a one-man regular research project at the Station, the accomplishments in the field of seed collection and treatment, nursery practice, and planting techniques have been so productive that the Station has maintained leadership in this field.

Even though nursery stock is now produced successfully in most parts of the South, and the majority of plantings are considered successful, many losses still occur because of faulty handling of seed, lack of information as to best nursery practices, and inadequate information on the choice of proper species and planting techniques in field operations. The Southern Station receives numerous requests for information in these fields and is repeatedly urged to conduct further investigations in all phases of artificial reforestation. Although many of these requests represent genuine needs, inadequacy of funds and personnel has permitted meeting only the few having most general and widespread applicability.

Many Station investigations in this field involve relatively long-time studies which are only now beginning to bear fruit. For example, a study to determine the effect of geographic source of seed, started in 1926, yielded some interesting and valuable results in 1941. In these 15-year-old loblolly pine plantations, trees grown from seed collected locally were 20 percent taller, 25 percent larger in diameter, and showed 20 to 50 percent less infection from rust canker than trees grown from seed of the same species obtained several hundred miles away. Further, evidence was found that success or failure in a plantation may depend more upon invisible qualities in the planting stock, presumably imparted by the soil conditions in the nursery, than on outward appearances such as are determined through empirical grading rules. This indicates the great importance of selecting superior nursery sites and in maintaining them at a high level of productivity. Spacing studies started in 1926 showed in 1941 that the commonly used spacings of 6x6 and 8x8 feet for slash and loblolly pines do not completely utilize the site during this first 15-year period and that closer spacings are therefore desirable. Such findings will result in many changes in present-day planting practices.

Most of the Station's work in this field has been concentrated on pine land problems. Only recently has it been possible to commence studies of artificial reforestation with hardwood species. Cottonwood appears to be one of the most promising for the bottom-land hardwood region. During the past 2 years considerable progress has been made in determining the best methods of planting cottonwood. It was found that cuttings must be planted prior to the beginning of the growing season to be successful. Also, competition of native vines and weeds is so severe that at least one cultivation or release is essential during the first growing season. Wild seedlings seem to offer some advantages over cuttings.

By such current contributions the Station's forest-regeneration program is aiding greatly to improve forest productivity on the most neglected forest lands of the South.

Naval Stores

One of the oldest and most important forest industries in the Lower South is the naval stores industry. This industry, which produces practically all of the rosin and turpentine used in this country and in normal times a large part of that used abroad, is confined to 30 million acres of the longleaf-slash pine type in the Southeast, the center of the industry being in southern Georgia and northern Florida. Nearly two-thirds of the rosin and turpentine now produced in this region is derived from the gum of the living tree; the distillation of stump and heart wood produces the remainder.

Wasteful woods practices have long been common in the gum industry. Working of small trees, placing of too many faces per tree, and deep and wide streaking have been everywhere in evidence, all of which has tended to reduce the sustained gum-producing capacity of the forests. The Station's early work therefore was aimed to determine the factors influencing gum yield, including the effect of size of trees, depth and height of streak, width of face, frequency of chipping, weather, etc. The results of this long-continued research have been published and given widespread distribution and their general application by the gum naval stores industry during the past two decades has resulted in increased efficiency of operations, greater returns to the operators, and reduced damage to the trees on which the industry must depend for its raw product. Although many aspects of turpentining practice have been explored, the opportunities for further improvements through research are almost unlimited.

The naval stores industry, along with other forest industries, has been subjected to wide fluctuations in demand and price of product. The decade from 1930 to 1940, for example, represented a period of relatively poor demand, excessive production, and low prices. Stocks of turpentine and rosin accumulated and widespread efforts were made, with the support of the Government, to curtail production. Since the start of the defense program, however, conditions have changed. Prices have risen, stocks of turpentine have been depleted, and heavy inroads are being made in accumulated rosin stock, so that at present there is an impending shortage of these materials. Because of their importance in the war effort, the Secretary of Agriculture has established a quota of 450,000 naval stores units (one unit equals one 50-gallon barrel of turpentine and 3-1/3 barrels rosin) for 1942, an increase of 165,000 units over 1941 production. To meet this increased quota in the face of a possible labor shortage will require a high degree of cooperative effort in the industry, and the assistance of many agencies, including forest research.

Two recent Station studies promise important contributions to the problem of increasing production. The one of most immediate application is that of chemical stimulation. Following the leads of European investigators, the Station in 1937 began a study of the effect on gum yields of applying certain chemical reagents to freshly cut streaks. Results to date indicate that slash pine responds remarkably well to certain chemicals whereas longleaf pine thus far has shown almost no stimulation. As much as 50 percent increase in yield has been obtained from slash pine using a 40 percent solution of sulphuric acid. Since over 50 percent of the trees operated are slash pine, the use of this method on a large scale would help greatly towards meeting increased war needs. However, difficulties are anticipated in obtaining early and widespread adoption of such a new and revolutionary technique. To get the maximum effect it is necessary to discover a method of stimulating yields from longleaf as well as slash pine. To that end, additional studies and field tests are fully justified and urgently needed.

The second recent Station investigation promises greatly increased naval stores yields, and perhaps may revolutionize forestry practice in the naval stores region. Over a period of many years Station studies have shown that certain individual trees produce much greater quantities of gum than do other trees of the same species, size, and growth rate. The ability of those trees to produce unusual quantities of gum is perhaps hereditary. If it were possible to propagate such highly productive trees, gum yields might be doubled or trebled. To speed up the process, the Station is attempting to find a means of successfully rooting slash pine cuttings. Although this has never before been accomplished, unusually promising results already have been obtained, by carefully controlling environmental factors and by the use of certain hormone and nutritional treatments. Many obstacles must be overcome before practical methods of vegetative propagation are an accomplished fact, including: (1) identification of stock known to be inherently highly productive in gum yield; (2) development of propagation methods applicable to such stock; and (3) extension of laboratory methods to practical and economical field operations on a large scale. In the last quarter century the application of research along these lines has had a truly revolutionary effect upon the production of plantation rubber.

During 1941, manuscript reports on the value of the advance streak and on chipping specifications for young vigorous slash pine were prepared. The recommendations they contain, if adopted, will further increase the productiveness of naval stores operations. An article on frequency of chipping, submitted for publication in 1941, also adds knowledge to this subject.

Although research in gum naval stores yields and extraction practices is highly important, the gum naval stores industry can be helped in other ways by forest research. The future of this industry is dependent not only on efficient gum extraction processes but also upon over-all forest management to perpetuate the supply and provide maximum returns from all forest products of which naval stores is but one. The future naval stores forest will yield not only income from gum, but a substantial and possibly greater income from other forest products. The forest landowner in the naval stores belt is confronted by many current forestry problems such as how to build up understocked stands, how to thin young slash pine, and how to reduce hazard from fire. The answers to these and many other questions dealing with forest management are being currently sought on the Station's Olustee Experimental Forest near Lake City, Fla. Here an experimental management plan is being put into operation which eventually will indicate the pattern for successful forest-management practice for the naval stores belt.

Farm Woodlands

Can we expect southern farm woodlands, which comprise fully 30 percent of the forest acreage of the region, to contribute significant quantities of forest products for war use? What potential contributions can these farm woodlands make to the general farm economy during the post-war period? An answer to these two important questions is indicated in recent Station studies of farm woodlands in Washington Parish, La., and Hempstead County, Ark., in cooperation with the Bureau of Agricultural Economics, Soil Conservation Service, and the respective State Agricultural Experiment Stations. Determinations were made of volumes of saw timber, pulpwood, and other forest products on farm woodlands, growth of timber, quantities of timber products used on farms and sold, market outlets, and prices received. This was followed by an evaluation of the present and potential contributions of typical small farm woodlands to the general farm economy in the areas studied. The findings, published in 1941, pointed out the practices required for good forest management, including probable yields, costs and returns, and the size of the farm woodland that could be worked per family during time unemployed in farming. The studies showed that properly managed farm woodlands can contribute significantly to present needs, and, during the post-war period, can contribute an important part of the total farm income.

Economics of Private Forestry

How to meet wartime demands for essential forest products and at the same time assure continuous supplies for future years is a vital problem confronting owners of southern forest lands. Approximately 93 percent of these lands is in private ownership. How to manage these forests to obtain greatest continuous yields of most valuable and essential products, and how to log and mill most efficiently, are of great importance to lumber, pulp, and other companies now turning out large quantities of war materials.

To answer such questions, the Southern Station, on its Crossett Experimental Forest in southeastern Arkansas, is determining: (1) the relative costs and returns from harvesting trees for sawlogs, pulpwood, posts, and other forest products, singly or in combination; (2) the size and age at which trees become financially mature for each of these products; (3) effect of stocking, cutting cycles, and intensity of selective cutting upon growth rate, yields, costs of logging, and costs and returns; (4) desirable logging methods; (5) costs and returns from various pruning, thinning, and improvement cutting practices; (6) effect of road type and spacing upon costs of truck logging; and (7) effect of controlled burning upon reproduction, growth, yields, and costs and returns. These studies have shown that light cuts at frequent intervals yield profitable returns, improve the growing stock both in quantity and in quality, increase volume growth, and decrease logging costs over those of clear-cut methods. The first draft of a comprehensive report covering many of these findings, entitled "Financial aspects of selective cutting in second-growth shortleaf and loblolly pine," was completed in 1941.

The Crossett Experimental Forest is visited each year by hundreds of lumbermen, pulpwood operators, and other timberland owners and foresters from all parts of the country. Many of the results and practices developed on this Experimental Forest have been adopted by private owners. The continuation of these studies is of great importance to the development of good forestry practices on many millions of acres of southern forest land.

Industrial Forestry

About 60 percent (75 million acres) of the forest land in the Lower South is in the hands of industrialists and private owners other than farmers. In 1938, the United States Forest Service estimated that more than 13 million of these acres were being managed with the objective of continuous production. Since then, the pulp and paper industry alone has increased its ownership under planned management to over 3 million acres in this region and several additional lumber companies have adjusted their cut to correspond to the yield of their forests. Altogether, it is estimated that more than 100 technically trained foresters are now employed in the Lower South by private companies.

A recent Station study of a large number of forest-land-owning companies revealed that those whose sole purpose is the production of raw forest products are spending more than 12 cents an acre annually, on the average, for management activities, including fire protection. Several lumber companies with plans for continuous production are spending only about 5 cents an acre annually for management. Other companies have been unable to see their way clear to adopting continuous production as a goal owing to the lack of forest resources (brought about by excessive cutting in the past) or to the pressure of heavy indebtedness. Although most of the latter make little or no outlay for land management, many spend up to 4 cents per acre annually, largely for fire protection on immature stands on cut-over areas. Many forest landowners, of course, spend nothing for protection or management.

Many of the technical foresters employed by lumber and pulp companies will join the active services and their going may cause some disruption to the sustained-yield plans of their companies. Many of the plans which have been adopted, however, will be executed by those who stay at home. Price restrictions and increased taxes may result in a reduction of forest-management expenditures, with a consequent slowing up of progress in industrial forestry under the pressure of war demands. On the other hand, forest owners and industries that produce forest material throughout the South are enjoying higher prices now than at any time in the last decade and many of them may be expected to invest in timberlands for continued production—the owner because of renewed faith in the profits to be had and the wood-using industries to assure themselves of future raw material supplies.

Forest Taxation

The forest tax problem in the Lower South, while difficult of solution, can be simply stated—in situations where taxes take such an undue portion of forest income as to threaten the inherent value of the property, they should be reduced. Otherwise owners will tend to "cut out and get out," the land will revert to the public through tax delinquency, and forest resources will be wantonly exploited.

The questions requiring determination are: (1) where do these conditions exist? and (2) what are the solutions? Current Station work in this field includes (1) a determination of current levels and recent trends in tax per acre of forest land and timber in each State of the Lower South, of which Louisiana was completed in 1941, and data for Alabama and Mississippi were brought up to date; and (2) assistance to those States desiring advice or detailed studies in forest tax legislation amendment or reform. This project should be of great importance in the post-war period when private forestry development will feel the let-down from a war-stimulated market and will require a sound tax structure to continue on a profitable basis.

FOREST SURVEY

Forest Resource Situation

Among the many large demands the war and defense programs have placed upon southern forest resources is the huge quantity of southern pine used for cantonments, which have sprung up overnight in every southern State; the Army has reserved several hundred thousand acres of forest land for maneuvers and bombing areas; pulp and paper companies have exceeded normal plant capacity to meet increased demands; and the need for naval stores and other forest products has grown tremendously.

What effect will war demands have on southern forest resources? One of the responsibilities of the Forest Survey is to estimate annually the net effect on the forest resources of increases due to growth and the decreases due to mortality and commodity drain. Such estimates have been made and published for each year since the survey made its first inventory, and were currently revised for 1936, 1937, and 1938; data are now being worked up for 1939 and 1940. A canvass of forest-products manufactures for 1941, in cooperation with the Bureau of the Census, will start shortly. When the cut for the last two years has been determined and compared with calculated growth and mortality, it will be possible to determine the trend of defense and war demands on the growing stock in the Lower South. Preliminary figures indicate that while the effect of the extraordinary war drain will be felt more heavily in some sections than in others, the Lower South as a whole has as yet suffered no irreparable inroads in its total growing stock. There can be no doubt, however, that in some sections the supply of sawlog-size timber has been subjected to such heavy overcutting that a decade and more must elapse before the damage can be repaired and the normal timber-producing capacity restored. It would be highly desirable if heavy war orders for lumber and other forest products could be so allocated as to avoid serious overcutting in local situations.

As the United States goes further into a wartime economy, the question arises, whether lumber production will actually decline as it did during World War I because of the recruitment of loggers and sawyers for war service, restriction of residential building, price restrictions causing shutdown of mills, and transportation difficulties. Or will we find that demand will expand and forests suffer additional deterioration? Whatever the answer, our forest resource must make a full contribution not only to the winning of this war but to "the winning of the peace" that follows. Intelligent allocation of the demands, however, could ward off serious overcutting in areas where the livelihood of communities is dependent upon maintenance of the forest growing stock. Forest Survey data could well be used for this purpose.

Land Use and Resource Planning

The incidence of the present war together with the recollection of the distressing aftermath of the last war gives emphasis to the necessity for national, regional, and community resource planning. The Southern Station has a large and growing responsibility in such planning activities in its region. Much of this work is centered in the Station's Forest Survey activities. Since 1930, the Station has made the first authoritative appraisal of the Lower South's forest resources and has gathered a great deal of other information basic to planning for maximum usefulness of the region's chief resource—its forests.

National and regional resource planning includes at least three wide fields. In order of urgency, they are:

(1) Planning for the efficient, speedy, and economical filling of war needs for forest products—such as construction material for cantonments, warehouses, and other military structures; material for military and naval equipment, wood for charcoal and explosives, turpentine and rosin for war uses, etc.

(2) Planning for the post-war period in which the forest must fill a major role in supplying raw material of all kinds to meet dammed-up civilian needs and to offer an opportunity for the employment of millions of men mobilized from the armed services and the war industries. Such planning must provide for industrial development and utilization as well as for an extensive rehabilitation of the forest itself which must inevitably suffer from the overcutting and hasty exploitation of the emergency period.

(3) Long-range planning—looking far beyond the immediate war and post-war period and designed to bring the South's forests into full production of both raw material and finished goods and to integrate this increased yield and manufacture into the everyday economy of the region. Such plans, too, must provide for the building up of an ample reserve of growing forest, in excess of anticipated current needs, to meet the necessities of future periods of emergency.

Station personnel and facilities are already engaged to a considerable extent in all three of these phases of planning activity, working in close cooperation with committees of the United States Department of Agriculture, the National Resources Planning Board, State Planning Boards, State Agricultural Planning Committees, and with the administrative office of the Forest Service at Atlanta. Much greater activity in this respect is anticipated in 1942.

FOREST INFLUENCES

It is the responsibility of forest-influences research to determine the basic principles of watershed management, including the methods of handling forest lands or manipulating watershed cover so as to conserve and properly utilize soil and water resources for maximum human benefit. The need for basic information of this kind in planning comprehensive land-use programs, such as those formulated in the Department of Agriculture's flood control surveys, is urgent. It is particularly unfortunate, therefore, that studies of the many critical watershed problems in the Lower South, particularly where forestry is the dominant land use, could not have been begun many years ago. Because forest-influences investigations can make large potential contributions to post-war planning studies and to other long-range conservation programs, these studies should be given high priority, even in the face of curtailment or postponement of many projected investigations.

In spite of curtailments in emergency funds and personnel during 1941, substantial progress was made in the Station's forest-influences investigations under way at the Irons Fork Experimental Forest in western Arkansas and at the Chewalla Experimental Forest in north Mississippi. The roadbank-stabilization studies yielded further results which were put into practice on the Ouachita and Holly Springs National Forests. An analysis was made of the forest-influences problems requiring investigation in the Ouachita Mountain region, and the first draft of a problem analysis report was prepared. The first permanent stream-gaging installation on the Irons Fork Experimental Forest was almost completed during the year.

current studies must contribute as far as possible to the war effort, and some of the information and experience from these investigations may prove useful in certain wartime activities. In fact, information regarding the best methods of controlling erosion on newly constructed roads has already been furnished on request to Army personnel charged with carrying on work of this kind at a large training camp in Mississippi. Experience in the use of vegetation for erosion control may be of use in protecting or camouflaging certain defense works or industries, and represents a type of service towards which the Station's previous work can make contributions. Although war needs for such information or services are still somewhat obscure, requests of this nature will be given first priority during 1942.

FLOOD CONTROL SURVEYS

The Department of Agriculture's flood control surveys, which have been under way since 1937, are mainly concerned with the formulation of programs of waterflow retardation and soil erosion prevention for the alleviation of flood damage. During 1941, the Southern Station, with the assistance of representatives of the Soil Conservation Service and Bureau of Agricultural Economics, completed a comprehensive revision of the survey report for the Little Tallahatchie River watershed in northern Mississippi (867,476 acres) and also completed the field work on a survey of the Upper White River in Arkansas and Missouri (6,214,400 acres). Work on the Yazoo watershed survey in northern Mississippi (4,119,040 acres) was approximately 50 percent completed at the end of 1941. The Station also cooperated on surveys of the Grand (Neosho), Middle Colorado, and Fourche-Petit Jean Rivers.

The Southern Station has cooperated since 1937 in detailed surveys of 11 drainage basins and in preliminary examinations on an additional 10 watersheds. These studies have been well distributed throughout the region, and in general have revealed that flood damages are of considerable economic importance in the great majority of drainage basins and in no small degree are the product of land misuse on the contributing watershed areas. Flood problems are known to be important in many watersheds not yet investigated, and a large and continuing program of such studies therefore lies ahead, if the problems of flood control are to be adequately dealt with.

Flood control investigations can contribute importantly to the solution of critical post-war problems. Various Federal, State, and local agencies are already actively engaged, under the leadership of the National Resources Planning Board, in planning programs of useful public works designed to develop and utilize wisely the Nation's natural and human resources. Under consideration are many types of projects to provide large-scale employment and serve other useful purposes during the post-war period; however, in future land-use programs to be financed wholly or in part from Federal funds, public interest requires careful planning to determine the economic worth of specific projects in terms of benefits. Flood control surveys meet this requirement, since they contribute definite plans of work that have been critically evaluated to insure that anticipated benefits exceed costs. Indeed, few types of land-use planning provide such detailed programs of corrective action or as complete an appraisal of economic returns as do flood control investigations.

The flood control surveys will also doubtless contribute to the post-war lanning work through the development of techniques that have applications in and classification, hydrology, watershed management, and other applied ciences. Some of these techniques should help to develop and evaluate pecific projects in many fields of resource planning.

Flood control surveys also contribute helpfully to the current war effort through special studies of critical areas where vital war industries and developments are subject to flood hazards. Wherever new defense industries and military bases in the South are menaced by floods, certain upstream control measures may provide immediate benefits. Special attention will be paid during 1942 to problems of this nature.

COOPERATING BUREAUS

Insects Affecting Forests and Forest Products
(Bureau of Entomology and Plant Quarantine)

The relative importance of insects that injure forests and forest products varies in different regions. In the Lower South, insects which damage forest products and forest plantations have created more problems than those injurious to standing timber or to seedlings in nurseries. Of special importance at this time is the control of certain insects which injure forest products needed for national defense.

The Texas leaf-cutting ant found in Louisiana and Texas often kills young pine seedlings soon after the trees are planted; Federal and State forest services have spent several thousand dollars in the last few years in control of this insect. Successful control was obtained during 1941 by applying methyl bromide at the rate of 1 pound in from 1 to 4 ant tunnels before trees were planted; the tunnels were left open, and not closed with earth. The cost of this chemical was 70 cents per pound and the cost of its application was about one-fourth of the cost of applying carbon disulfide. Like all other chemicals tested, methyl bromide is not effective during the summer months. Methyl bromide, while dangerous if inhaled, is not as hazardous to use as is the inflammable and explosive carbon disulfide, and less labor is involved. Experiments will be continued in 1942 to find cheaper and more effective fumigants.

The pine tipmoth kills the terminal shoot, distorts and retards the growth of young southern pine trees, mostly shortleaf and loblolly. Experiments have indicated that while chemical control is ineffective, silvicultural control, by the use of better grades of planting stock and by planting on better-quality sites, will greatly reduce the injury and consequent loss.

Lyctus powder-post beetles cause an estimated loss to hardwood lumber and wood products in the United States of at least $18,000,000 each year. Research has shown that dipping seasoned lumber or wood products for 5 minutes in a solution of 5 percent pentachlorphenol and light petroleum fuel oil not only kills these beetles, but prevents reinfestation; this treatment costs about $1 per thousand feet. This method of control was established recently at U. S. Army arsenals and storage depots as standard practice for protecting gunstock blanks, implement handles, wooden wheels, and tent stakes from beetle attack.

Termites cause annual losses in the United States estimated at $40,000,000. On the Harrison Experimental Forest near Saucier, Miss., studies are being conducted to determine the conditions of temperature, humidity, and ventilation most favorable for termites to construct their earth-like shelter tubes, and under conditions similar to those found in damaged buildings. A laboratory technique is being developed to give quicker results in testing the relative value of different types of metal and other termite shields to determine the most effective type of shield and the entomological principles which influence their effectiveness under actual service conditions.

Cooperation on defense work. As a part of the country-wide defense program in 1941, architects, project managers, and Army and Navy officials were informed of the most effective methods of termite-proofing the foundations of cantonments and defense housing in the Southern States. Tests of chemical soil poisons to protect the foundations of buildings and of preservatives for the control of termites attacking wood, plywood, and fibre boards are being made currently. Special efforts will be made in 1942 to cooperate with national defense agencies on the war effort.

Diseases of Forests and Forest Products
(Bureau of Plant Industry)

The Nation's war effort, which is making heavy demands on the southern lumber industry, has emphasized the problem of wood decay. Most of the wood in the South now available for war needs is fast-grown pine sapwood, relatively nondurable as contrasted with the slower-grown heartwood previously cut from original-growth timber stands.

Surveys are under way in the Lower South to determine the prevalence of decay and the influence of house design and construction on wood decay. Defense housing projects in Texas, Louisiana, and Mississippi were inspected in 1941 to determine decay hazard. In order to determine the minimum foundation ventilation needed to prevent decay in buildings, extensive studies of wood and soil moisture content under buildings were begun. These indicate that substructure wood-moisture content is more closely correlated with soil moisture under the building than it is with the amount of ventilation.

Present stands of the four common southern pine species are largely fast-growing second growth, relatively free from the heartrots that were prevalent in the virgin forest. However, certain diseases formerly unimportant have in recent years become increasingly serious. Outbreaks of one of these diseases, caused by a rust, Cronartium fusiforme, have been noted with increasing frequency in the southern portion of the Lower South, east of the Mississippi River. Part of the increase in this disease probably can be laid to the natural invasion by loblolly and slash pines of extensive areas originally in longleaf pine. Loblolly and slash pines, which are important in planting programs, are very susceptible to infection by this disease, which alternates during its life cycle on pines and oaks. Furthermore, the prevalence of clear cutting in the longleaf pine region and protection from fire during the last decade have favored the development of oaks, which prior to logging existed as shrubs in the understory of the longleaf forest. The extension of the rust-susceptible loblolly and slash pines to areas where oaks are abundant no doubt has favored the rapid increase of the disease. Also, unrecognized rust infections occurring while seedlings were still in the nursery have been found responsible for serious losses after the trees have been planted in the field. Although spraying of nursery stock at the W. W. Ashe nursery in Mississippi in 1940 indicated successful control, spraying at the same nursery in 1941 indicated little benefit from such treatment. Direct measures to control the rust under forest conditions, such as eliminating oaks and pruning out cankers, are usually impractical. Surveys of the rust on slash and loblolly pine are being made to determine how these pines can be safely grown in relation to the concentrations of the alternate oak host; also, how a mixture of slash and loblolly pines affects the rust hazard to the slash pine. Periodic examinations of specific trees are being made to provide a continuous record of the course of the disease.

Current studies and surveys will be continued in 1942, with special emphasis on their relation to war needs.

Forest Biology
(Fish and Wildlife Service)

The relation of birds and rodents to the natural regeneration of longleaf pine continues to be an important problem on millions of acres of understocked cut-over longleaf pine lands in the Lower South. Even in years when there is a very good longleaf seed crop, relatively few new seedlings become established. Studies have been under way for several years to ascertain the cause for this condition, and how it can be remedied. Preliminary investigations showed that rodents were a minor factor in the destruction of longleaf pine seed, but that certain birds (blackbirds, mourning doves, quail, and meadowlarks) were largely responsible. Experiments are under way to determine what silvicultural practices will prevent the ravages of these birds.

The effect of fire in this connection was given primary consideration in 1941. Plots were established on recent burns, and a careful check was made of the destruction of seed by mourning doves and meadowlarks. Attempts were made to correlate natural seeding at different times after fires with seeding on unburned areas. Seasonal plantings were undertaken to compare results obtained in the late winter and early spring with those obtained in the late fall. It was found that birds were attracted to recent burns, and that longleaf pine seed was almost entirely destroyed, irrespective of the season of planting.

This study will be continued along similar lines on the Harrison Experimental Forest in Mississippi and on the Olustee Experimental Forest in Florida. Attempts will be made to devise methods whereby bird depredations can be eliminated. It is also planned to make a study of the wild turkey on the DeSoto National Forest, to obtain information on its life history, natural enemies, food preferences, and means of increasing its present numbers.

PUBLICATIONS
Jan. 1, 1941 - Dec. 31, 1941

Boggess, W. R., Swarthout, P. A., and Toole, E. R. - Results of the survey on the little-leaf disease of southern pines in Alabama. Ala. Agr. Expt. Sta. Dept. Mimeograph. 15 pp., illus. Sept. 28, 1941.

Bond, W. E. - Farm woodlands in defense. South. Lumberman 163 (2057): 207-210, illus. Dec. 15, 1941.

________ and Rhodes, R. R. - Forestry as a farm enterprise in Washington Parish, La. Occasional Paper No. 100. Southern Forest Expt. Sta. 23 pp. Oct. 10, 1941.

Bruce, David - The new longleaf-slash pine fire-danger meter. The Dixie Ranger 7 (1): 1-2. Jan. 1941.

Bull, Henry, and Putnam, J. A. - First-year survival and height growth of cottonwood plantations at Stoneville, Miss. Occasional Paper No. 98. Southern Forest Expt. Sta. 16 pp. Jan. 17, 1941.

Burleigh, Thomas D. - Barn swallow breeding in southern Alabama. The Auk 58 (2): 261-262. Apr. 1941.

________, and Sutton, George Miksch. - Birds recorded in the State of Hidalgo, Mexico, by the Sample Expedition of 1939. Annals of the Carnegie Museum 27: 169-186. Jan. 10, 1941.

Ceremello, Peter J. - Olustee Experimental Forest - a glimpse of its work. AT-FA Jour. 4 (1): 8, Oct. 1941. South. Lumber Jour. 45 (10): 77, Oct. 1941. South. Pulp and Paper Jour. 4 (3): 129, Oct. 1941. South. Lumberman 163 (2052): 38, Oct. 1, 1941. Naval Stores Rev. 51 (28): 10, Oct. 11, 1941.

Christian, M. B. - Biology of the powder-post beetles, *Lyctus planicollis* Leconte and *Lyctus parallelopipedus* (Melsh.). Parts I and 2. Louisiana Conserv. Rev. 9 (4): 56-59, illus., winter 1940-41; and 10 (1): 40-42, illus., spring 1941.

Craig, Ronald B. - The past and future of forest taxation in Mississippi. The Conservationist 7 (9): 5, 11. Jan. 1941.

________ - Post-war tax policies and forestry. South. Lumberman 163 (2057): 223-225, illus. Dec. 15, 1941.

________ - Taxes on forest property in nine selected counties of Alabama, 1937-40, and in seven selected counties of Mississippi, 1936-40. Occasional Paper No. 99. Southern Forest Expt. Sta. 13 pp. May 27, 1941.

________ - Tax on timber in Alabama studied. Alabama Conserv. 1 (7): 9, 13, illus. May 1941.

Daniels, Herbert - How far can you see? The Dixie Ranger 7 (8): 7-8. Aug. 1941.

Demmon, E. L. - Forest research aids the national defense program. Naval Stores Rev. 51 (15): 8, 10. July 12, 1941. South. Lumberman 163 (2047): 46-47. July 15, 1941. Published under varying titles in: Alabama Conserv. 13 (2): 8, 13, Aug. 1941. Service Bulletin 25 (13): 1-3, June 23, 1941. AT-FA Jour. 3 (10): 8, 9, July 1941.

__________ - Forestry's place in our present agricultural program. The Rural Louisianan 3 (3): 4-5, illus. Dec. 1941.

__________ - Growth of the pulp and paper industry in the South. Michigan Forester, pp. 14-15, 62-64. Univ. of Michigan. Forestry Club Annual. 1941.

__________ - Opportunities for Hevea rubber plantations in Latin America. Caribbean Forester 2 (4): 188-192. July 1941.

__________ - Southern forestry - past, present, and future. South. Lumberman 163 (2057): 213-218, illus. Dec. 15, 1941.

__________ - The southern forests and the pulp and paper industry. South. Pulp and Paper Jour. 4 (5): 40, 42, 44, 46, 72. Oct. 1941.

__________ - Twenty years of forest research in the South, 1921-1941. South. Lumberman 163 (2049): 29-31, Aug. 15, 1941. Cong. Rec. 87 (123): A3409-A3411, June 30, 1941.

Gemmer, E. W. - Loblolly pine establishment as affected by grazing overstory, and seedbed preparation. Jour. Forestry 39 (5): 473-477. May 1941.

Hunt, George M., and Snyder, T. E. - An international termite exposure test - twelfth progress report. 37th Ann. Meeting of the American Wood-Preservers Assoc., Louisville, Ky., Feb. 4-6, 1941.

Lehrbas, M. M., and Eldredge, I. F. - Forest resources of south Georgia. U. S. Dept. Agr. Misc. Pub. 390, 50 pp., illus. Jan. 1941.

Liefeld, T. A. - Increased naval stores production from chemically treated streaks. Naval Stores Rev. 50 (4): 10, 13, 15. Jan. 4, 1941.

__________ - What is the life of steel fence posts? Jour. Forestry 39 (11): 960. Nov. 1941.

Meginnis, H. G. - Soil losses from southern roadbanks. Service Bulletin 25 (9): 10. Apr. 22, 1941.

Nelson, Mary L. - Polyembryony in seeds of southern pine. Jour. Forestry 39 (11): 959-960. Nov. 1941.

Olsen, C. F. - Analysis of the Honey fire. Fire Control Notes 5 (4): 161-172. Oct. 1941.

Pessin, L. J. - Review: Fused needle disease and its relation to the nutrition of Pinus. By H. E. Young. Queensland Forest Serv. Bull. 13, 108 pp. 1940. Jour. Forestry 39 (3): 343. Mar. 1941.

Pessin, L. J.	- Review: Obshtchii Lesovodstvo. (General Forestry.) By M. E. Tkatchenko, A. I. Asoskov, and V. I. Sinev. 746 pp. Leningrad. 1939. Jour. Forestry 39 (1): 74. Jan. 1941.
______, and Burleigh, Thomas D.	- Notes on the forest biology of Horn Island, Miss. Ecology 22 (1): 70-78, illus. Jan. 1941.
Reynolds, R. R.	- Economical spacing of forest roads. South. Lumberman 163 (2057): 165-168, illus. Dec. 15, 1941.
______	- Five years of selective cutting. (Address delivered before meeting of American Railway Tie Assoc., Hot Springs, Ark., May 22, 1941.) South. Lumberman 163 (2047): 54-57, illus., July 15, 1941. Conservation News Digest, p. 2, Aug. 9, 1941, Natl. Lbr. Mgfrs. Assoc. Published under title: Selective cutting pays big dividends to turpentine farmers. AT-FA Jour. 8 (10): 11, illus., July 1941.
______	- Some principles of farm woodland management. (Address delivered before Soil Conservation Service Training School, State College, Miss., Sept. 4-6, 1941.) Miss. Farm Research 4 (9): 6. Sept. 1941. Miss. Agr. Expt. Sta.
Snyder, T. E., and Zetek, James	- Test house on Barro Colorado Island resists termites and decay. Wood Preserving News 19 (7): 80-82, illus. July 1941.
Southern Forest Experiment Station	- Southern Forestry Notes Nos. 37-42. Jan., Mar., May, July, Sept., and Nov. 1941.
Stone, E. L., and Smith, L. F.	- Hail damage in second-growth longleaf pine. Jour. Forestry 39 (12): 1033-1035, illus. Dec. 1941.
Stover, W. S.	- What are defense orders doing in the woods? South. Lumberman 163 (2057): 195-197, illus. Dec. 15, 1941.
Swarthout, Paul A.	- Some observations on the use of slash pine wildlings as planting stock. Slash Pine Cache 4: 27-31, illus. Univ. of Florida. Forest Club Annual. 1941.
Verrall, A. F.	- Dissemination of fungi that stain logs and lumber. Jour. Agr. Res. 63 (9): 549-558. Nov. 1, 1941.
______	- Fungi associated with stain in chemically treated green lumber. Phytopathology 31 (3): 270-274. 1941.
Wahlenberg, W. G.	- Methods of forecasting timber growth in irregular stands. U. S. Dept. Agr. Tech. Bull. 796, 56 pp. Dec. 1941.
Wakeley, Philip C.	- Estimate of the 1941 cone crops of southern pines. Mimeographed. 4 pp., 4 maps. Aug. 23, 1941.
______	- Some principles of forest planting on farms. (Address delivered before Soil Conservation Service Training School, State College, Miss., Sept. 4-6, 1941.) Mimeographed. 12 pp.

Wakeley, Philip C. - Suggestions for uniformity in forest planting. (Address delivered before Forestry Section of the Assoc. of South. Agr. Workers, Atlanta, Ga., Feb. 7, 1941.) Proc. 42d Ann. Convention of Assoc. of South. Agr. Workers, Feb. 5-7, 1941. Abstract on pp. 145-146.

UNPUBLISHED ADDRESSES

Bickford, C. A. - Fire danger rating, man power, and fire damage appraisals. Southern States Cooperative Fire Control Conference, Tishomingo State Park, Miss., May 26-29, 1941.

__________ - Fire effects and use. Priest River Meeting, Priest River, Idaho, Dec. 2-6, 1941.

Chapman, Roy A. - The sampling error in a finite stratified population. New Orleans Acad. of Sci., Mar. 28, 1941.

Craig, Ronald B. - Forest taxation in Alabama. Alabama Acad. of Sci., Montgomery, Ala., Mar. 21-22, 1941.

Eldredge, I. F. - Dedicatory address before District Headquarters Unit of the Louisiana Division of Forestry, Hammond, La., Aug. 23, 1941.

Hawes, N. E. - Irons Fork Experimental Forest. First Annual Extension Service Study Day, Mena, Ark., Apr. 29, 1941.

Ineson, F. A. - Place of forests in the general social and economic structure. Sigma Chi Forum, Baton Rouge, La., Mar. 5, 1941.

Smith, W. R. - Flood Control Survey. Civic Meeting, Oxford, Miss., during National Defense Week, Jan. 31, 1941.

A13.- 1:1942

AGRICULTURAL REFERENCE DEPARTMENT
CLEMSON COLLEGE LIBRARY

TWENTY-SECOND ANNUAL REPORT

SOUTHERN FOREST EXPERIMENT STATION

New Orleans, Louisiana

E. L. Demmon, Director

1942

U. S. Department of Agriculture
Forest Service

Contents

Page

Introduction 1

Forest-products surveys for the War Production Board 2

Increasing naval stores production 2
    Chemical stimulation 2
    Propagation experiments 3

Preparing for the post-war period 4

Cooperating bureaus 5
    Insects affecting forests and forest products 5
        (Bureau of Entomology and Plant Quarantine)
    Diseases of forests and forest products 5
        (Bureau of Plant Industry)
    Forest biology 6
        (Fish and Wildlife Service)

Publications 6

TWENTY-SECOND ANNUAL REPORT
SOUTHERN FOREST EXPERIMENT STATION
1942

INTRODUCTION

In this war year, the usual form of annual report for this Station has been abandoned. Instead, a very brief resumé of achievements for 1942 is being made, summarizing the correlation of the Station's work with wartime problems. Many regular research projects have been shelved temporarily or placed on a maintenance basis; new war projects have been started. The importance of planning for the post-war period has not been overlooked as the Station anticipates taking an active part in preparing for a constructive southern forestry program after the war. The current research program is organized to give practical results of immediate wartime value, and also to prepare for the future peace.

As with most organizations, the Station has felt the effect of loss of manpower to the war effort. By the end of 1942, 18 of its members were serving with the armed services and 21 more had transferred to civilian war agencies.

In May 1942, the Navy commandeered the Station's office quarters in the Federal Building in New Orleans, necessitating a move to the Standard Oil Building, about 2 miles from the center of town. Field work other than that carried on for the War Production Board is now concentrated at a few experimental forests; active work on the Chowalla and Harrison Experimental Forests in Mississippi, and on the Hitchiti in Georgia, has been terminated for the duration of the war. Two of the three units making up the Palustris Experimental Forest in Louisiana have been taken over by the Army, one for a cantonment site and the other for an artillery range. The Crossett Experimental Forest, however, was enlarged in March 1942 by 1,800 acres leased from the Crossett Lumber Co. The harvesting of forest products from the Olustee Experimental Forest required in the various studies is being facilitated through two cooperative agreements, one covering the sale of naval stores, and the other, pulpwood and other forest products.

The Station has curtailed its publications and during 1942 put out but two Occasional Papers and one Survey Release. Southern Forestry Notes were discontinued with the October 1942 issue. Nevertheless, numerous Station articles were printed in forestry and lumber trade journals during the year. A list of publications appears at the end of this report.

In addition to carrying on its own war projects, the Station has cooperated with numerous war agencies by furnishing services of its trained staff as well as in an advisory capacity. Station men have served on certain State and local USDA war boards, and on State and regional land-use and post-war planning committees. The Station has furnished assistance to war agencies in: (1) developing cork oak plantations in the region; (2) planting of kok-saghyz, the rubber-bearing Russian dandelion; (3) freeing air fields from undesirable vegetation; (4) camouflaging air fields and other military installations; (5) measuring infiltration rates of soils in connection with the drainage of airfield sites; (6) increasing production of meat and dairy products from forest lands to help meet wartime demands; (7) securing information bearing on priority requests for logging and milling equipment; (8) obtaining better fire protection on critical areas; and (9) an extensive series of surveys and investigations in cooperation with the War Production Board in forest-products supplies.

Major program emphasis during 1942 was given to two projects: (1) gathering information on supplies, production and requirements of forest products, and determining causes and remedies for delays or handicaps to production; and (2) methods of increasing the production of the critical war materials turpentine and rosin.

FOREST-PRODUCTS SURVEYS FOR THE WAR PRODUCTION BOARD

During 1942, most of the manpower of the Division of Forest Economics and Forest Survey was devoted to forest-products surveys for the War Production Board. These surveys included the preparation of the following reports for each of 8 Southern States: (1) a monthly report of lumber production; (2) a quarterly report of lumber stocks; (3) a quarterly report on factors affecting lumber production; and (4) a periodic report of the status of log inventories. In addition, special requests involved the following: (1) a study of pulpwood production, timber supplies, and transportation and equipment difficulties affecting present and future production of pulp and paper products; (2) a study of the possibilities of manufacturing wooden rosin barrels in the naval stores belt to replace steel barrels now commonly used for packaging rosin; (3) a brief survey of the outlook for package veneers with which to meet the needs of fruit and vegetable packaging in the South; (4) a number of spot surveys of equipment needs at individual lumber-producing plants; and (5) two special reports on the status of log inventories.

Preliminary to the surveys and studies mentioned above, data on forest area and volume and on estimate of the 1941 lumber cut were assembled for each of the 600 counties in the Station's territory.

The forest-products surveys are being conducted in cooperation with Region 8 of the Forest Service, the Tennessee Valley Authority, and two lumber associations—Southern Pine Association and Southern Hardwood Producers. After devising an adequate sampling system, 700 mills distributed through all parts of the region and representing 8 different size classes were selected as a basis for gathering monthly, quarterly, and other periodic estimates. Of these sample mills 500 are visited each month and the others are contacted through the lumber associations.

The Station cooperated with the Bureau of the Census in its annual canvass of lumber production; all Census returns from over 7,000 mills passed through this office for editing before going to the Bureau. In March 1942, on the basis of data from 1,300 identical mills, the Station made a preliminary estimate of production that was used by all interested agencies pending the final results of the canvass.

INCREASING NAVAL STORES PRODUCTION

Chemical Stimulation

Early in 1942, the Secretary of Agriculture established a 1942 war goal for gum naval stores of 450,000 units (1 unit equals one 50-gallon barrel of turpentine and 3-1/3 barrels of rosin), an increase of 58 percent over 1941 production. With a growing labor shortage and scarcity of supplies, it was apparent that difficulty would be encountered in obtaining this level of production. Station studies promised substantial aid in meeting this war need.

Experiments which had been under way for several years in the use of chemicals to stimulate gum flow from turpentine streaks seemed to offer the best promise. These experiments had shown that application of 40 percent sulphuric acid solution to the freshly cut streak increased gum yields as much as 60 percent on slash pine. Although no similar stimulation was obtained for longleaf, it was felt that further experimentation might yield a chemical treatment effective on both pines.

Three lines of approach were tried during 1942: (1) 24 different chemicals, in various concentrations, were tested on about 1,000 experimental trees; (2) in cooperation with the A.A.A. Naval Stores Conservation Program, pilot plant tests were conducted on 20 commercial operations, using a 40 percent solution of sulphuric acid on slash pine; (3) a study of the effects of chemicals on the physiology and anatomy of turpentined trees was started.

It was found that applications of sulphuric acid increase the period of gum flow to 2 weeks or more as compared with a normal of 2 days for usual chipping methods. Chipping every other week and applying sulphuric acid gave approximately as much yield on both slash and longleaf as did the usual weekly chipping practice without acid. Such use of chemicals offers great possibilities for maintaining naval stores production under rapidly diminishing supplies of experienced chipping labor.

Caustic soda, one of the new chemicals tested, appears very promising on both longleaf and slash pine with regular weekly chipping. In a preliminary experiment, a 25 percent solution of this chemical gave 118 percent more gum than the check. A more comprehensive experiment started in midseason gave 40 percent more gum. Caustic soda seems to have a cumulative effect on gum production, and for a full season yield increases in excess of 40 percent seem probable.

The pilot plant tests using 40 percent sulphuric acid applied weekly gave an average of 25 percent increase in yields for the first 4 months of the 1942 season. Some of these tests showed yields up to 60 percent over the check.

Recommendations for 1943 practices have been prepared for the use of the industry. Where labor shortages are pressing, the 40 percent sulphuric acid treatment applied biweekly is recommended. Where the labor supply is sufficient, weekly chipping and application of a 25 percent solution of caustic soda is recommended.

Arrangements have been made to test both of these treatments on a pilot plant scale as a part of the 1943 A.A.A. Naval Stores Conservation Program. The use of caustic soda will be more fully explored in the 1943 research program. Other treatments suggested as a result of the fundamental investigations will also be thoroughly tested.

Propagation Experiments

Propagation of superior yielding trees as a means of increasing naval stores production, a project initiated in September 1941, made remarkable advances during 1942. After an extended search throughout the naval stores region in an attempt to isolate superior parent stock for propagation purposes, 8 unusually high yielding trees were selected. These trees were found to produce from 2 to 3 times as much gum as ordinary trees of similar size and development growing nearby. Plans are to use them as a source of material for propagation.

Mature cuttings of slash pine were successfully rooted in 1942. As far as is known, this is the first time that this class of material has been successfully rooted. The techniques used were essentially new in tree propagation work, consisting of the use of high-pressure sprays over nursery beds exposed to both full sunlight and partial shade. The environment needed to propagate this class of stock has been largely defined. A critical current problem is to control stem rot which frequently spreads following the establishment of roots.

Experiments will be continued to perfect the rooting technique so that large-scale production of superior planting stock will be feasible.

PREPARING FOR THE POST-WAR PERIOD

During the post-war period, the South will doubtless face many economic and social problems which commonly follow a great world conflict. A basic requirement is that all able-bodied persons must be provided with gainful work in order to avoid wholesale unemployment, disastrous shifts in population, dissipation of natural resources, and other phases of an economic depression. Underlying the objective of full-scale employment after the war is the need for increased industrial enterprises, which will necessitate a rehabilitation of the soils, forests, and other resources on which industry must subsist. When the war ends, none of the South's major resources will be more in need of rehabilitation than will its forests, since an exorbitant wartime drain is steadily depleting available wood supplies. Furthermore, the South has fallen far short of attaining full production from its forest lands, even in peace times.

In order to make ready for post-war adjustments, local and regional plans aimed at forest rehabilitation must be prepared and be properly coordinated with agricultural and industrial development plans. These forest restoration plans must prescribe the measures required to put forest lands in productive condition; furthermore, they must appraise the cost and the economic justification of these measures.

During 1942, the Station made substantial contributions to the solution of post-war problems in several specific areas. A report on the Little Tallahatchie drainage basin in Mississippi, which recommends a comprehensive forestry and agricultural program in aid of flood control, was completed. A similar study for the watershed of the Yazoo River upstream from Yazoo City, Miss., has also been substantially completed. In cooperation with the National Resources Planning Board, a preliminary plan was prepared for restoring to full productivity the 39 million acres of commercial forest land in the Arkansas-Red River basin in Arkansas, Missouri, Louisiana, Oklahoma, and Texas.

Other Station work in 1942 included: (1) the maintenance of research records deemed essential to current and post-war needs, and (2) the preparation of several articles and manuscripts containing information of value to the war effort and to post-war planning. These writings covered such subjects as pruning of southern pine; loblolly pine reproduction in central Alabama; effect of source of loblolly pine seed on plantation development; planting and management of cottonwood; effects of fire on longleaf pine establishment; southern pine volume tables; forest resources of Alabama, Georgia, and Louisiana; forest tree seed (part of a United States seed manual); first draft of a comprehensive monograph on longleaf pine; final revision of a manuscript on the financial aspects of selective timber management in shortleaf and loblolly pine.

COOPERATING BUREAUS

Insects Affecting Forests and Forest Products
(Bureau of Entomology and Plant Quarantine)

Of special importance at this time is the control of insects which injure forest products needed for the war.

Lyctus powder-post beetles cause an estimated loss of at least $18,000,000 each year to southern hardwood lumber and wood products. Wood of high starch content (oak, ash, pecan), with moisture content ranging from 6-32 percent, is most susceptible. Specifications were prepared for the Treasury Department requiring that susceptible hardwood lumber be chemically dipped to prevent Lyctus-infested lumber from being exported.

Termites cause annual losses in the United States estimated at $40,000,000. Studies are under way in southern Mississippi to determine the conditions of temperature, humidity, and ventilation most favorable for termit to construct their earth-like shelter tubes, under conditions similar to those found in damaged buildings. Tests of the relative value of different types of metal and other termite shields to determine the most effective type of shield and the entomological principles which influence their effectiveness under actual service conditions have been completed, and the findings will soon be published.

Cooperation in the war program. As a part of the country-wide war program, architects, housing project managers, and Army and Navy officials in the South were advised as to the most effective methods of termite-proofing the foundations of cantonments and war housing projects. Tests of chemical soil poisons to protect the foundations of buildings and of preservatives for the control of termites attacking wood, plywood, and fibre boards are continuing.

Diseases of Forests and Forest Products
(Bureau of Plant Industry)

The regular forest pathology program was confined to certain phases of the building decay and pine rust projects having an important bearing on post-war problems. Most of the 1942 effort, however, was directed at problems related to the war. Chief among these was a search for new chemicals or new chemical mixtures that could be used, if necessary, for controlling stain in seasoning lumber to replace or reduce the amounts of the standard stain-control chemicals where shortages are critical. Several new chemicals appear promising but further testing is needed before these can be recommended for commercial use. It was also found that the concentrations of the phenolic and mercuric dips could be reduced to about one-fourth the usual concentration by the addition of 10 lbs. of borax or 22 lbs. of soda per 50 gallons of solution, without seriously reducing their effectiveness.

The staff participated in a nation-wide survey of decay occurrence in boats and aircraft. Samples of southern oaks were collected for a study of durability for use in boat construction.

Forest Biology
(Fish and Wildlife Service)

Activities for 1942 were materially curtailed due to transportation difficulties. No new projects were started, but established plots on the Harrison Experimental Forest were maintained. Field work consisted primarily of studies of bird life distribution in southern Mississippi. Special field trips were made to Newfoundland and Mexico.

PUBLICATIONS
Jan. 1, 1942 - Dec. 31, 1942

Arend, John L. - Infiltration as affected by forest floor. Proc. Soil Sci. Soc. 6: 430-435. 1941.

Bickford, C. A. - The use of fire in the flatwoods of the Southeast. Jour. Forestry 40 (2): 132-133. Feb. 1942.

Bond, W. E. - Extra dollars from farm forests. Chapter in "Farm Adjustment Opportunities in Washington Parish, Louisiana," by K. L. Bachman and R. J. Saville. U. S. D. A. Bureau of Agr. Econ. and Louisiana Experiment Station. Pages 46-60. May 1942.

Brinkman, K. A., and Swarthout, P.A. - Natural reproduction of pines in east-central Alabama. Ala. Agr. Expt. Sta. Cir. 86. 12 pp. 1942.

Bull, Henry - How much profit in pruning old-field loblolly pine? South. Lumberman 165 (2081): 229-232. Dec. 15, 1942.

Burleigh, Thomas D. - A new barn swallow from the Gulf Coast of the United States. La. State Univ. Occasional Papers of the Mus. of Zoology No. 11. Pages 179-183. Mar. 4, 1942.

______ and Lowery, George H., Jr. - An inland race of Sterna albifrons. La. State Univ. Occasional Papers of the Mus. of Zoology No. 10. Pages 173-177. Mar. 4, 1942.

______ and Lowery, George H., Jr. - Notes on the birds of southeastern Coahuila. La. State Univ. Occasional Papers of the Mus. of Zoology No. 12. Pages 185-212. Mar. 4, 1942.

Ceremello, P. J. - Carpet grass sod on forest roads. AT-FA Jour. 4 (5): 12. Feb. 1942. Naval Stores Rev. 51 (47): 4. Feb. 21, 1942.

______ - Forest management research in the Southeast. Jour. Forestry 40 (2): 138. Feb. 1942.

Craig, R. B. - Mississippi's forest bank account. South. Lumberman 165 (2081): 211-212. Dec. 15, 1942.

______ - Taxes on forest property in nine selected parishes of Louisiana, 1937-40, in nine counties of Alabama, 1937-41 and in seven counties of Mississippi, 1936-41. Occasional Paper No. 101. Southern Forest Expt. Sta. 23 pp. May 15, 1942.

Curry, John R. - Fast growing trees make profits after 16 inches diamete
Forest Farmer 1 (8): 1. May 1942.

__________ - War goals and naval stores research. Jour. Forestry 40 (9): 735-736. Sept. 1942.

Demmon, E. L. - Forest raw materials of Louisiana. Chapter in "Resources of the New Orleans Region Available for Chemical and Allied Industries." New Orleans Assoc. of Commerce. Pages 56-67. 1942.

__________ - Our forests and the future. Arkansas Farmer 44 (12): 8. Dec. 1942.

__________ - Periodicity of forest fires in the South. South. Lumberman 165 (2081): 220-222. Dec. 15, 1942.

__________ - Research aids to southern forestry. Jour. Forestry 40 (2): 154-157. Feb. 1942.

__________ - Rubber production opportunities in the American tropics. Jour. Forestry 40 (3): 207-210. Mar. 1942.

__________ - Southern forests and the war. South. Pulp and Paper Jour. 5 (5): 50, 52-53. Oct. 1942.

__________ - The South's pine forest problem. Future 4 (8): 24-25. Apr. 1942.

__________ - Twenty years of forest research in the Lower South. Jour. Forestry 40 (1): 33-36. Jan. 1942.

Eldredge, I. F. - Forestry in the future of the South. Jour. Forestry 40 (2): 140-142. Feb. 1942.

Hunt, George M., and Snyder, T. E. - An international termite exposure test - thirteenth progress report, 38th Ann. Meeting of the American Wood-Preservers' Assoc., Minneapolis, Minn., Jan. 27-29, 194

Hutchison, S. Blair - Alabama: Number one lumber state of the South. South. Lumberman 165 (2081): 235-237. Dec. 15, 1942.

Ineson, F. A. - Forest resources of the South and probable drain. (Address delivered before meeting of the South. Assoc. for the Advancement of Sci., Atlanta, Ga., Apr. 2, 1942. Summary in South. Pulp and Paper Jour. 5 (1): 20. June 1942.

__________ - Southern forest resources and the war. (Address delivered before meeting of the Forestry Section, Assoc. South. Agr. Workers, Memphis, Tenn., Feb. 4-6, 1942. Delivered before La. State Univ. Soc. of Foresters, Baton Rouge, La., Mar. 3, 1942. Delivered before Ala. Acad. of Sci., Howard College, Birmingham, Ala., Mar. 20-21, 1942.) Proc. 43d Ann. Convention Assoc. South. Agr. Workers, pages 155-156. Alabama Conserv. 13 (10): 11, Apr. 1942. Jour. Forestry 40 (7): 519-522, July 1942.

Knorr, Philip - Variations in fire-danger factors on a Ranger District in the longleaf pine region. Jour. Forestry 40 (9): 689-692. Sept. 1942.

Liefeld, T. A. - Chemical stimulation results for year of 1941 are announced. AT-FA Jour. 4 (5): 14-15, Mar. 1942. Naval Stores Rev. 52 (5): 10, 12, May 2, 1942. Published under title: "A progress report of chemical stimulation results for 1941."

______________ - How important is the advance streak? AT-FA Jour. 5 (3): 8-9, Dec. 1942. Naval Stores Rev. 52 (39): 8, 10, 12, Dec. 26, 1942.

______________ - Relation of naval stores yields to frequency of chipping. Jour. Agr. Res. 64 (2): 81-92. Jan. 15, 1942.

______________ and Chapman, R. A. - Preliminary analysis of commercial acid-stimulation tests under the 1942 naval stores conservation program. AT-FA Jour. 4 (12): 7, 11, Sept. 1942. Naval Stores Rev. 52 (23): 10, 12, Sept. 5, 1942.

Lockard, Charles R. - A goal for forestry in the Lower South. South. Lumberma 165 (2081): 187-191. Dec. 15, 1942.

Meginnis, H. G. - Post-war opportunities for forest industrial development in the Arkansas Valley. South. Lumberman 165 (2081): 213-217. Dec. 15, 1942.

Mesavage, Clement - The next forest inventory in the Lower South. South. Lumberman 165 (2081): 238-240. Dec. 15, 1942.

Mitchell, H. L. - The development of a high-yielding strain of naval store pine. (Address delivered before 21st Ann. Meeting of th Ga. Forestry Assoc., Savannah, Ga., May 8, 1942.) Naval Stores Rev. 52 (7): 10, 12, May 16, 1942. AT-FA Jour. 4 (7): 8-9, May 1942. Published under title: "Vegetative methods offer promising short cuts in propagating the high yielding pine trees."

______________ - Studies regarding the development of a high-yielding strain of naval stores pine. (Address delivered before Ann. Meeting of Forest Farmers Assoc. Cooperative, Jan. 16, 1942, Jacksonville, Fla.) Forest Farmer 1 (11): 1, 3, Aug. 1942. Published under title: "Better tree strain sought in tests at Experiment Station."

______________ Schopmeyer, C. S., and Dorman, K. W. - Pedigreed pine for naval stores production. Science 96 (2503): 559-560. Dec. 18, 1942.

Muntz, H. H. - Integrated utilization in bottomland hardwoods. South. Lumberman 165 (2081): 193-194. Dec. 15, 1942.

Possin, L. J. - Recommendations for killing scrub oaks and other undesirable trees. Occasional Paper No. 102. Southern Forest Expt. Sta. 5 pp. May 18, 1942.

Possin, L. J. - Review: A short history of the plant sciences. By Howard S. Reed. 320 pp. Jour. Forestry 40 (6): 509-51 June 1942.

Reynolds, R. R. - Everyone loses when timber burns. (Delivered before Crossett Rotary Club, Mar. 26, 1942.) A. C. B. A. Visitor (Hamburg, Ark.) 2 (4): 3. Apr. 1942. Forest Echoes (Crossett, Ark.), Nov. 1942.

——————— - Review: Loggers' Handbook. Vol. 1. Truck Logging. Edited by Truman W. Collins and A. Whisnant. 156 pp. Pacific Logging Congress, Portland, Oreg. 1941. Jour. Forestry 40 (12): 968-969, Dec. 1942.

Schumacher, F. X., and Chapman, R. A. - Sampling methods in forestry and range management. Duke Univ. School of Forestry. Bul. 7. 213 pp. Jan. 1942.

Snow, A. G., Jr. - A new argument for controlled burning. Dixie Ranger 8 (4): 1. Apr. 1942.

Southern Forest Experiment Station - Southern Forestry Notes Nos. 43-46. Jan., Mar., May, and Oct. 1942. (Discontinued with No. 46.)

Stover, W. S. - Forest resources of the Delta Section of Mississippi. Forest Survey Release No. 53. Southern Forest Expt. St 28 pp. June 15, 1942.

Verrall, A. F. - A comparison of *Diplodia natalensis* from stained wood and other sources. Phytopathology 32: 879-884. 1942.

UNPUBLISHED ADDRESSES

Craig, R. B. - Southern forests at war. WWOE, New Orleans, La., Aug. 24, 1942.

Curry, John R. - Forest management for maximum yield and profit. Forest Farmers Assoc. Cooperative, Jacksonville, Fla., Jan. 16, 1942.

——————— - Naval stores from southern pines. WWOE, New Orleans, La., Aug. 26, 1942.

Demmon, E. L. - Louisiana's forests and the future. Louisiana Section, Amer. Soc. of Civil Engineers, New Orleans, La., Oct. 5 1942.

——————— - Texas forests and the future. Ann. Meeting of the Texa Acad. of Sci., College Station, Tex., Nov. 14, 1942.

Meginnis, H. G. - Louisiana's cut-over land problem with particular reference to the development of the forest and livestoc industries. State Conference called by Governor Sam H. Jones for the development of pasturage in Louisiana, Baton Rouge, La., Nov. 19-20, 1942.

Possin, L. J. - Native trees for southern gardens. WWOE, New Orleans, La., Mar. 20, 1942.

AGRICULTURAL REFERENCE DEPARTMENT
CLEMSON COLLEGE LIBRARY

TWENTY-THIRD ANNUAL REPORT

SOUTHERN FOREST EXPERIMENT STATION
New Orleans, Louisiana

E. L. Demmon, Director

1943

U. S. Department of Agriculture
Forest Service

Contents

Page

Introduction 1

Investigations and surveys for war agencies 1
- Determination of current lumber production 1
- Estimate of lumber stocks on hand at mills 2
- Factors affecting lumber production 2
- Cooperation on lumber census 2
- Keeping the forest survey up to date 2
- Other investigations 3

Chemical stimulation to increase naval stores production 3

Wartime livestock production on forest ranges in the Gulf area 4

Prescribed burning 5

Emergency rubber projects 5

Cork oak 6

Financial aspects of industrial forestry 6

Pedigreed pine for naval stores production 6

Cottonwood 8

Cooperating bureaus 8
- Insects affecting forests and forest products 8
  (Bureau of Entomology and Plant Quarantine)
  - Termite-proofing of buildings in the war construction program 8
  - Protection of forest products and fabrics needed for the war 8
- Diseases of forests and forest products 9
  (Bureau of Plant Industry)
- Forest biology 9
  (Fish and Wildlife Service)

Publications 10

TWENTY-THIRD ANNUAL REPORT
SOUTHERN FOREST EXPERIMENT STATION
1943

INTRODUCTION

During 1943, the Southern Station continued to focus its attention on meeting wartime needs. Normal forest research activities, already greatly curtailed, were kept to the minimum necessary for essential maintenance of going research projects and planning for the post-war period.

Most of the personnel in forest economics and forest survey have been engaged in gathering for the war agencies essential information on current requirements, production, available supplies, and consumption of forest products. This information is needed in developing and controlling the war production programs, and is financed in part by the War Production Board.

In the field of forest management, major efforts have been directed to methods of increasing the production of gum naval stores. The output of turpentine and rosin, basic materials in the war economy, has been steadily decreasing since Pearl Harbor. Chemical stimulation of naval stores timber offers promise for increasing gum production and this lead is being followed actively at the Station's Lake City, Fla., branch, as one means to the end of preventing the supplies of these strategic materials from declining even further.

Forest influences investigations, which had been under way at the Station since 1929, were closed down entirely in 1943. Flood control surveys also were suspended for the duration of the war, following completion of a report on the Yazoo drainage basin in Mississippi.

One new and important activity was initiated during 1943. Recognizing the importance of southern forest land in the production of beef cattle, Congress for the first time appropriated funds to start a small research project of beef cattle production in Louisiana. In addition to the long-time benefits, this project has the immediate aim to increase meat production during the war by developing improved practices on forest ranges.

Further reduction in regular Station funds and loss of personnel to the armed services necessarily have handicapped continuity and efficiency of Station output. Also, in August 1943, the Station again was forced to seek new office quarters and is now located in City Park, about 3 miles from the business center of New Orleans.

This report gives highlights of the most important Station activities during 1943. No effort is made to cover in detail each of the various projects under way or to appraise southern forest problems from the standpoint of research needs. Such details must await the end of the war. A list of Station publications which appeared in print during 1943 is appended at the end of the report.

INVESTIGATIONS AND SURVEYS FOR WAR AGENCIES

Determination of Current Lumber Production

Estimates of monthly lumber production of the 9,000 sawmills in the 8 States of the Lower South were made throughout the year. Dependence was placed largely on mail returns from 1,100 sample mills, followed by telegraphic requests and occasional visits to the delinquent mills. The sample was stratified among mills of all sizes from portable outfits cutting only 50,000 board feet a year to the large permanent installations producing more than 50 million feet. Through cooperation with the Southern Pine Association and Southern Hardwood Producers, Inc., reports of their member mills were made available for these estimates.

Each month an estimate was prepared showing total lumber production for each State by species, and by large, medium, and small mill size classes. The procedure was set up so that the estimates for the region as a whole would have an accuracy of within 5 percent. The production figures have been used by Government war agencies in determining policies, in the preparation of regulations, and in the actual allocation of lumber by the WPB to claiming agencies—Army, Navy, Maritime Commission, lend-lease, and other direct war agencies—as well as to essential civilian use.

Estimate of Lumber Stocks on Hand at Mills

Each of the sample mills cooperating in the survey of monthly lumber production reports on the volume of pine, hardwood, and cypress lumber in its yard as of the last day of each quarter. These stock reports include all lumber on hand, whether produced by the particular mill or purchased from other mills, whether rough and green or dried and dressed, whether obligated or unobligated. The data are used by the same agencies and for the same purposes as are the monthly lumber production figures.

Factors Affecting Lumber Production

During the year, Station men visited hundreds of mill operators and workers throughout the region to discuss with them their problems of maintaining or increasing production, to get their viewpoint on present and future conditions in the industry, and their reaction to various regulations, including ceiling prices and market controls. This information has formed the basis for quarterly reports on factors affecting lumber production. These reports discuss such factors as the supply, quality, and stability of labor in the woods and mills, availability of logging and milling equipment and parts, relationship of costs of production to ceiling prices, weather conditions, timber availability, markets, and other factors. Such reports help to direct policies of the War Production Board, Office of Price Administration, and other war offices, to aid the Timber Production War Project and other field agencies in their attack on various problems, and to keep the members of the industry posted, all to the end of maintaining an adequate flow of lumber to the war effort.

Cooperation on Lumber Census

The Station received and edited 12,653 mill Census lumber production returns of which 68 percent were obtained in the field by Station men. As a result, the Bureau of the Census probably has the most accurate census of lumber production ever made in the South. Accurate Census figures of lumber production are basic to an understanding of the industry and are particularly essential during wartime.

Keeping the Forest Survey Up to Date

Owing to shortages of personnel and other disturbances caused by the war, the job of keeping the forest survey up to date has fallen behind. At the same time, the need for information as to the current supply of timber in the Lower South, for both war and post-war planning, has become acute. To meet this situation it was necessary to design a streamlined method of applying growth and drain to the forest inventories established by the survey and thus to bring the statistics forward with sufficient accuracy to serve the emergency. This was done and gave preliminary figures of board-foot growth, drain, and resulting growing stocks up to January 1, 1943, for each of the 8 States in the Lower South. The calculation of preliminary data covering cubic-foot growth, drain, and growing stock was started towards the end of 1943, but will not be completed until sometime in 1944.

Other Investigations

During 1943, a number of special studies and reports were made, to guide wartime policy-making in Washington. Among these were: (1) a determination of the dry-kiln capacity of all the plants in operation in the Lower South; (2) a survey of the rosin-barrel situation to discover the extent to which wooden barrels could be substituted for metal packages; (3) a survey of the veneer package situation (a diversion of veneer to war uses threatened the supply of packages for fruit and vegetables); (4) estimate of fuelwood requirements and fuelwood supplies; (5) survey of stocks at retail lumber yards in the region; (6) computation of volume, quality, and distribution of certain critically needed species.

CHEMICAL STIMULATION TO INCREASE NAVAL STORES PRODUCTION

Turpentine and rosin, commonly known as naval stores, enter directly into the production of such war materials as shrapnel, waterproofing for tents, insulatic for ships, smoke screens, smokeless powder, and anti-fouling paint for the Navy; they are used also in the manufacture of other essential items, including variou chemicals and drugs, plastics and adhesives, synthetic rubber, insecticides, linoleum, matches, paint, varnish, lacquer, paper and paper size, printing ink, synthetic camphor, and soap.

Production of gum naval stores has fallen off at an alarming rate during the pas 3 years, chiefly because of shortage of woods labor. The total output in 1942 was 323,000 units (a unit is 50 gallons of turpentine and 1,400 pounds of rosin) as compared to a war goal of 450,000 units set by the Secretary of Agriculture for that year. 1943 production probably did not exceed 290,000 units, or far below the goal of 350,000 units. The statistical situation in rosin is alarming Lend-lease requirements alone are estimated to equal or exceed existing Government stocks. The outlook for 1944 is definitely pessimistic.

Chemical stimulation of gum yields seems to offer the most feasible solution to the production problem. Early in 1942, the Southern Station, anticipating war demands, intensified its program of research on this method of gum extraction. The best chemical treatment then available was recommended to the industry and tried for the first time on large-scale operations. It consisted of applying 40 percent sulphuric acid once each week to freshly chipped streaks. With this method, commercial operators were enabled to increase gum yields by from 20 to 38 percent, with a corresponding increase in profits of from $300 to $850 per crop (10,000 trees) per season.

Intensified research in 1942 resulted in the development of two new chemical treatments. One, a weekly caustic soda treatment, under commercial practice, gave yield increases up to 49 percent, and additional net profits up to $1,200 per crop per season. The chief advantage of the second treatment—acid applied every other week to biweekly chipping—was its labor-saving feature. This treatment gives normal or better production with half the amount of labor.

Another treatment developed in 1943 shows even greater possibilities. This consists of applying 40 percent sulphuric acid weekly to very shallow streaks which remove only the bark but do not penetrate the wood. On an experimental basis, this method increased gum yields from 60 to 75 percent. When carefully applied to timber of average quality, it should increase yields by at least 60 percent, and profits by 65 percent. With better-quality timber, results should be proportionately better. Another treatment—applying acid to streaks made every third week--shows promise of approximately normal production with only a third of the labor.

Conservative estimates indicate that if chemical treatments now available are applied to even a third of the timber expected to be in production in 1944, the goal of 300,000 units can be met in spite of the increasing scarcity of labor, and a serious shortage of naval stores thus be avoided.

Further research may produce even better treatments in the future. Additional concentrations and combinations of chemicals should be tested to find the most efficient ones for industrial use. These experiments should be conducted on a sufficiently large scale to offer convincing proof of their possibilities.

An equally important job is the removal of obstacles to widespread use of chemical treatments now available, including: (1) Development of satisfactory equipment (such as an acid- and alkali-resistant spray gun) to apply the chemicals to the trees. (2) Chemical stimulation, being a new and drastic departure from accepted practice, requires considerable extension and service work to acquaint the industry with its use. (3) Some producers are concerned about the long-time effect of chemicals on the health of the trees. Current studies should be continued, to detect possible signs of danger well in advance of commercial practice; to contribute to a better understanding of gum synthesis and flow and the effect of chemicals thereon; and to point the way to improved techniques.

WARTIME LIVESTOCK PRODUCTION ON FOREST RANGES IN THE GULF AREA

The problem of improving livestock production on forested areas is important to bettering rural conditions in the South. Increased production of meat and milk will permanently benefit this region, both in meeting deficient diets of farm families and in bettering incomes. However, not until 1943 were funds made available for forest range research at the Southern Station, and then only a limited amount was appropriated for studies in Louisiana. During the last 3 months of 1943, an extensive survey was made of cattle grazing on forest ranges in Louisiana, in cooperation with the State Agricultural Experiment Station. Early publication of the results of this survey is planned, and will be aimed towards increasing meat production for war needs.

Preliminary findings were issued in livestock journals and news releases, through the Extension Service, to help meet the 1943 drought-caused feed shortage, and to reduce starvation losses during the critical 1944 spring period.

Probably three-fourths of the 1,366,000 cattle and calves and most of the 260,000 sheep in Louisiana obtain at least part of their yearlong sustenance from native forage on the 16 million acres of forest range in the State. With additional development of improved pastures, the livestock population in the State undoubtedly could be increased on a sound nutritional basis by one-third within the next 5 years. Such a growth is entirely compatible with good forest land management but it will require careful planning to attain better seasonal grazing of forest range and to provide adequate yearlong nutrition and care of animals, particularly during winter and early spring when forest forage is at a minimum.

Well-managed cattle herds produce calf crops of 65 to 85 percent, with 350- to 400-pound calves, and annual death losses are 2 percent or less, whereas poorly managed operations have calf crops of only 30 to 40 percent, with 250- to 300-pound calves, and annual losses of 10 percent or more. Grazing on forest land can provide a supplemental income to help carry taxes and other fixed charges and also helps keep down fire hazard. Furthermore, full range utilization encourages the spread of better forage plants.

One of the most important problems facing users of forest range is the determination of the best season to graze cattle on native forage as a complement to improved pastures, cover crops, farm-grown feeds, and purchased feeds. It is planned to study this problem on pine forest ranges in 1944 through (1) determining animal preferences as to plant species and season of grazing, and (2) collection and chemical analyses of range forage samples to determine seasonal nutritive values.

PRESCRIBED BURNING

An extended drought during the 1942-43 winter fire season, a shortage of experienced fire-control men, and over-normal activity of fire-causing agencies made this the most serious fire season experienced in the southern pine region during the past decade. Losses in the longleaf-slash pine forests of the Southeast were particularly severe. This is a region where fire protection during the past several years has resulted in the establishment of dense, vigorous stands of young slash pine, along with a heavy undergrowth of high inflammability. In these stands, wildfires burn fiercely and cause extensive damage.

Fire losses in 1943 reawakened interest in the technique of prescribed burning—the use of fire to remove the hazardous accumulation of dead grass and underbrush without appreciable damage to the timber stand. The Southern Station has been studying the effects of fire in the South for a great many years, and it was natural that many timber owners and managers should seek advice from the Station. To fill a long-felt need the Station published in August 1943 Occasional Paper No. 105, "The Use of Fire in the Protection of Longleaf and Slash Pine Forests." This paper describes methods by which a timberland owner may determine the applicability of using fire on his forest land. It also outlines safeguards and desirable practices in the use of fire, in the longleaf-slash types.

EMERGENCY RUBBER PROJECTS

The Station contributed to the goldenrod rubber project being conducted by the Forest Service at Waynesboro, Ga. The work consisted of laying out and sampling plots to measure the effect of soils, selections (clones propagated vegetatively, each from a single original plant with leaves having a high rubber-content percent), density of stand, fertilizer, class of planting material, date of planting, date of harvest, and cultural methods upon the yield of goldenrod rubber.

The Station also assisted in designing the experimental sowings of Russian dandelion (kok-saghyz) at Belle Glade, Fla., and Napoleonville, La.

CORK OAK

During 1943, the Station also assisted in establishing a study to determine which national forest area in the South might best serve as a permanent source of cork. Plots were established on 6 national forests, embracing a wide variety of soil and climatic conditions, and the effects of 3 different seed sources and 2 different sites were tested in combination with all 6 climatic and soil complexes. Direct-seeding was depended upon, but a supplementary study of other methods of propagation was made on the Harrison Experimental Forest (Miss.). Despite unfavorable weather during 1943, results were distinctly encouraging.

FINANCIAL ASPECTS OF INDUSTRY FORESTRY

The economic studies which have been under way on the Crossett Experimental Forest in southeast Arkansas for several years have become increasingly valuable. Information on the dollars-and-cents aspects of forestry will be particularly important in the period immediately following the war.

In the course of work during 1943 some interesting figures were gathered on the employment requirements of well-managed timberlands. There is a certain amount of forest work that varies but little in man-hour requirements regardless of forest stocking or growth. The man-hour requirements per acre per year for this type of work are as follows:

Road development and maintenance	0.5	man-hour
Fire suppression and prevention	0.4	"
General supervision, marking, scaling	0.4	"
Equipment maintenance and crew supervision .	1.0	"
Total	2.3	man-hours

The man-hour requirements for cutting, transporting, and primary milling vary with type of product. These rates, based on a large volume of logs, pulpwood, acidwood, and fuelwood, are as follows: Sawlogs, 31.2 man-hours per M feet, International ¼" scale of logs made into finished lumber; pulpwood, 21.3 man-hours per standard cord of wood made into kraft paper, f.o.b. car; acidwood, 19.8 man-hours per standard cord of wood made into charcoal and recoverable chemicals; fuelwood, 15.2 man-hours per standard cord made into split wood and delivered to consumers.

On the basis of this Crossett study, the man-hour requirements for the present understocked, second-growth stands of shortleaf-loblolly pine west of the Mississippi River are 3.0 man-days per acre per year. For fully stocked stands, 4 man-days per acre per year would be required.

To use another approach, 60.2 acres of well-stocked and well-managed forest land would provide full-time employment to 1 man, and 10,000 acres would provide full-time employment to 166 men, in woods and manufacturing plants.

PEDIGREED PINE FOR NAVAL STORES PRODUCTION

The gum naval stores industry has been losing ground for many years, with production falling from a peak of 750,000 units in 1906 to less than 300,000 units in 1943. This decrease in production has been due chiefly to the increase in competition from substitutes, especially mineral spirits. Market conditions for naval stores have, of course, improved since the beginning of the war. Actually, the war-stimulated demand for turpentine and rosin has been so great that every effort is now being made to bolster production and thus avoid a critical shortage of these essential materials. After the war, however, serious economic ills may again depress this $25,000,000-a-year industry unless it can compete favorably with substitutes.

Major costs in naval stores operations are for labor: installing cups and gutters, chipping each tree weekly, and collecting the gum at frequent intervals throughout the season (March to October). In today's scattered, understocked stands of timber, costs of operation are considerably higher than they were in the original virgin forests, but differ little from crop to crop. Consequently, costs are largely dependent upon the amount of gum produced. The most promising way of reducing costs, therefore, is by increasing average gum yields per tree.

In 1942, the Southern Station started work on the development of extra-high-yielding strains of naval stores pines. This seemed the most economic way to permanently rejuvenate the naval stores industry which, in normal times, supports some 50,000 workers and dependents.

The naval stores belt was searched for trees of exceptional yielding capacity. Of the thousands of trees examined, 12 were eventually found which produced from 2 to 3 times as much gum as average run-of-the-woods trees. These superior individuals were selected as the "foundation sires" of the high-yielding strains to be developed.

The next problem was to multiply these superior trees by vegetative means, such as by rooting slips or cuttings therefrom, which is the only sure way of transmitting the high-yielding characteristics to the offspring. Southern pines had never before been propagated vegetatively. However, with the aid of plant hormones and special watering techniques, a few cuttings were induced to root. In 1943, methods were developed for rooting up to 35 percent of all cuttings thus treated. Experiments now in progress give promise of even better results. Research in propagation is being pointed toward the development of vegetative techniques which will be practicable for large-scale use.

In an effort to produce trees of even higher yielding capacity than the best found in nature, a controlled breeding program was begun in 1943, using selected superior trees. Pollen from these trees was introduced under carefully controlled conditions into the female flowers of superior trees. This is the process by which rubber yields have been doubled and redoubled in the last 25 years. The odds are that these crosses will produce individuals superior to either parent or to anything likely to occur in nature.

Plantations established with stock propagated from high-yielding trees should produce at least twice as much gum as the present average of 8.3 pounds per tree or 190 barrels per crop. Since it costs no more to work good than poor timber, a yield increase of this magnitude would increase net profits from the present average of $1,890 per crop per season to an estimated $4,950—an increase of 162 percent. On a per-acre basis, the comparison is even more striking, chiefly because present stands are so understocked that they average only 20 trees per acre. One hundred trees to the acre is more nearly the desired number from the standpoint of gum yields and efficiency of operation. It is estimated that with superior trees planted 100 to the acre, the net income per acre would be $49.50, as compared to the present average of $3.78.

COTTONWOOD

Cottonwood is one of the most rapid-growing forest trees in the South and also produces valuable lumber with a wide variety of uses. It grows normally in dense, pure, even-aged stands, mainly on sand bars and flooded areas along the Mississippi River. Following cutting at 20 to 50 years of age, cottonwood stands revert to more tolerant species; reproduction of these stands by natural means is decidedly unpromising. Because of its high potential increment (800 bd.ft. per acre per year), information as to its regeneration habits is in present demand.

A project in bottomland hardwood management has been under way since 1939, in cooperation with the Mississippi Agricultural Experiment Station. A study of cottonwood planting methods has been a major part of this research project. In August 1943, a summary of results was published as Bulletin 391 of the Mississippi Agricultural Experiment Station, "Planting Cottonwood on Bottomlands." This bulletin describes nursery and planting practices for this important hardwood species.

COOPERATING BUREAUS

INSECTS AFFECTING FORESTS AND FOREST PRODUCTS
(Bureau of Entomology and Plant Quarantine)

Termite-proofing of Buildings in the War Construction Program

Experiments on the effects of temperature, ventilation, humidity, soil moisture, and the presence of wood debris on the building of shelter tubes over foundations by subterranean termites have been completed. Soil moisture was found to be the most important factor; it can be controlled to a large degree by drainage and ventilation. A study of the moisture content of foundation timbers indicated that such timbers usually have a moisture content equal to that of air-dried wood; in consequence ventilation requirements have been lowered. The most effective type of metal termite shields for use over foundations has been determined; these can be used advantageously to supplement other methods of good construction in protecting buildings.

Where buildings are already infested with termites, large-scale tests of soil poisons applied in the soil surrounding foundations have shown that several chemicals are effective where untreated wood or other cellulose materials are removed from contact with the ground.

Since wood is a critical structural war material used extensively in the construction of barracks and storage deposts, many of which are located in the tropics, it is essential to prolong its life as far as possible. A recent publication (U.S.D.A. Circular No. 683) recommends several wood preservatives for use in the construction of war housing, wooden bridges, and wooden vessels in the tropics.

Protection of Forest Products and Fabrics Needed for the War

Simple and cheap chemical dips have been recommended to protect susceptible green hardwood lumber from attack by Lyctus powder-post beetles which cause serious damage to shipbuilding and aircraft lumber, implement handles, gunstock blanks, wooden artillery wagon wheels, and other military equipment in storage. Much material shipped under "lend-lease" is being inspected and, where necessary, those vitally needed supplies are being given remedial treatments.

Several chemical sprays have been developed for use in protecting green logs and lumber, such as those used in the manufacture of boats and aircraft and for naval life rafts, from serious injuries caused by pinworm or ambrosia beetles.

Cooperative tests of cotton fabrics used in clothing, cartridge belts, firehose, tents, and sandbags have demonstrated that certain copper compounds afford protection from termites as well as from mildew and decay.

Data are being supplied currently to military and civilian Government officials on the identity, distribution, habits, ecological requirements, and seriousness of damage caused by termites in several areas of the present global war.

DISEASES OF FORESTS AND FOREST PRODUCTS
(Bureau of Plant Industry)

The 1943 program in pathology consisted mainly of war-related problems in products pathology and certain phases of the pine rust project that have a bearing on post-war forest management problems.

Extensive field testing of chemical mixtures containing mainly noncritical borax was continued to determine their suitability for stain control on southern lumber. Mixtures containing as little as ¼ pound of Lignasan or 1 pound of Dowicide G or Santobrite and 10 pounds of borax per 50 gallons were found to be generally satisfactory on pine and hardwoods. Mixtures containing Dowicides H or P and borax were effective for controlling log stain in hardwoods but, as with Lignasan and Dowicide, were not effective when beetle damage was appreciable.

Further examinations were made of Army training planes to determine if factors exist that might lead to early decay. A number of Latin American woods that are being used in emergency construction were placed under test to determine their relative durability.

Studies of the rust problem on southern pines were continued. With reference to the practicability of spray control of the disease in forest nurseries, it was shown that inoculum infective to pines may be produced on oak leaves in a minimum of 7 days after aeciospore inoculation. The seasonal duration of the stage of the rust infective to pines lasted, in 1943, from the middle of April to the middle of June, in southern Mississippi.

Pruning of cankered branches reduced losses in slash pine plantations, but should be done before the cankers reach the stem. Excision of stem cankers to save seedlings is of doubtful value, as the development of stem-pruned seedlings is retarded in proportion to the amount of foliage removed. To test differences in susceptibility to the fusiform rust between strains of slash pine from different geographic sources, slash pine seed from 5 States (South Carolina, Georgia, Alabama, Mississippi, and Louisiana) were sown, and the seedlings will be planted early in 1944.

FOREST BIOLOGY
(Fish and Wildlife Service)

Because of transportation difficulties, field work was largely curtailed throughout 1943, and activities confined to the preparation of a detailed report on the bird life of the Mississippi Gulf Coast, based on 8 years' records. When published, this will be the first comprehensive report on the birds of Mississippi.

PUBLICATIONS

Jan. 1, 1943 - Dec. 31, 1943

Arend, John L., and Horton, Robert E. - Some effects of rain intensity, erosion, and sedimentation on infiltration-capacity. Soil Sci. Soc. Amer. Proc. 7: 82-89. 1942.

Bickford, C. A., and Curry, John R. - The use of fire in the protection of longleaf and slash pine forests. Occasional Paper No. 105. Southern Forest Expt. Sta. 22 pp. Aug. 15, 1943. Excerpt in The Forest Farmer 3 (1): 6. Oct. 1943. Published under title: "Research men issue fire bulletin."

Bond, W. E. - Farm forestry as a supplemental enterprise. Published as a chapter in "Adjustments in farm organization for increasing farm income in Hempstead County." By Trimble R. Hedges and M. W. Slusher. Ark. Agr. Expt. Sta. Bul. 442. Pp. 59-72. June 1943.

Bull, H. - Pruning practices in open-grown longleaf pine in relation to growth. Jour. Forestry 41 (3): 174-179. Mar. 1943.

———— and Muntz, H. H. - Planting cottonwood on bottomlands. Miss. Agr. Expt. Sta. Bul. 391. 18 pp. 1943. Mississippi Farm Research 6 (12): 3-5. Dec. 1943.

———— and Reynolds, R. R. - Management of loblolly pine. Comments on Prof. H. H. Chapman's bulletin entitled "Management of loblolly pine in the pine-hardwood region in Arkansas and in Louisiana west of the Mississippi River." Yale Univ., School Forestry Bul. 49. Jour. Forestry 41 (10): 722-726. Oct. 1943.

Campbell, R. S. - Trees, grass and cattle in the Gulf States. South. Lumberman 167 (2105): 171-173. Dec. 15, 1943. Excerpt in Mississippi Forests and Parks 9 (8): 12-13. Dec. 1943.

Chapman, R. A.; House, Lennon; and Liefeld, T. A. - Results of commercial acid-stimulation tests under 1942 naval stores conservation program. The AT-FA Jour. 5 (10): 8-9. July 1943. Naval Stores Rev. 53 (15): 8, 10, 12. July 10, 1943.

Craig, R. B. - The little fellow and the 1942 lumber cut of the Lower South. South. Lumberman 167 (2105): 159-160. Dec. 15, 1943. Excerpt in Mississippi Forests and Parks 9 (8): 5. Dec. 1943.

Curry, John R. - Forty acre woodlot nets $3.31 per acre under management. The Forest Farmer 3 (2): 1, 3. Nov. 1943. Continued: The Forest Farmer 3 (3): 3. Dec. 1943. Under title: "Curry gives detailed methods of securing high annual yields."

———— - Selection, propagation, and breeding of high-yielding southern pines for naval stores production. Jour. Forestry 41 (9): 686-687. Sept. 1943.

Demmon, E. L. - East Texas forests and the future. Occasional Paper No. 103. Southern Forest Expt. Sta. 10 pp. Jan. 16, 1943.

______________ - A forest conservation program for Louisiana. La. Conservationist 1 (4): 3, 7, illus. Mar. 1943.

______________ - A forestry program for the Lower South. South. Lumberman 167 (2105): 200-202. Dec. 15, 1943.

______________ - Louisiana forests and trade possibilities with Latin America. New Orleans Port Record 1 (6): 13-15. Feb. 1943.

______________ - Louisiana's forests and the future. Occasional Paper No. 104. Southern Forest Expt. Sta. 12 pp. Feb. 1, 1943.

______________ - Mississippi's forests and the future. Delta Council News 4 (3): 1, 3. Jan. 21, 1943.

______________ - Southern forest opportunities. Ames Forester 31: 7-14. 1943.

______________ - The South's forest frontier and the war. Social Forces 21 (4); 397-405. May 1943.

DeVries, Wade E.;
Craig, R. B.;
and Hall, R. C. - Taxation on Florida forests in 1942. 26 pp. Mimeo. 1943.

Eldredge, I. F. - Forestry development. Published as a chapter in "Regional Planning, Part XI, The Southeast," by National Resources Planning Board. Pp. 82-91. 1942.

Hunt, George M.,
and Snyder, T. E. - An international termite exposure test - fourteenth progress report, 39th Ann. Meeting of the American Wood-Preservers' Assoc., Chicago, Ill., Apr. 27, 1943.

Hutchison, S. Blair - Licking the lumber gremlins. South. Lumberman 167 (2105): 203-205. Dec. 15, 1943.

Johnston, H. R. - Laboratory tests of termite shields. Jour. Econ. Ent. 36 (3): 386-392. June 1943.

Liefeld, T. A.;
Chapman, R. A.;
and Snow, A. G., Jr. - What is new in chemical stimulation? The AT-FA Jour. 5 (4): 8-9. Jan. 1943.

____
Chapman, R. A.;
and Snow, A. G., Jr. - Chemical stimulation treatments recommended for 1943 operations. Naval Stores Rev. 52 (46): 8, 10. Feb. 13, 1943.

Lockard, C. R. - Where are we now? South. Lumberman 167 (2105): 237-238. Dec. 15, 1943.

McCulley, R. D. - Selective cutting is not a cure-all. The Forest Farmer 2 (11): 4. Aug. 1943.

Mesavage, Clement - Estimating monthly lumber production in the Lower South. South. Lumberman 167 (2105): 175-177. Dec. 15, 1943.

Mitchell, H. L., and Dorman, K. W. - Profits from chemical stimulation. Part 1. Profits from weekly sulphuric acid treatment. The AT-FA Jour. 5 (9): 8-10. June 1943. Naval Stores Rev. 53 (14): 8, 10, 12. July 3, 1943. Part 2. Possibilities for profit from weekly caustic soda treatment. The AT-FA Jour. 5 (10): 5-7. July 1943. Naval Stores Rev. 53 (16): 8, 10, 12. July 17, 1943. Part 3. Possibilities for profit from bi-weekly sulphuric acid treatment. Naval Stores Rev. 53 (18): 10, 12, 14, 17. July 31, 1943. The AT-FA Jour. 5 (11): 6-9. Aug. 1943.

Muntz, H. H. - Farm woodland owners urged to produce timber. Delta Council News 4 (8): 3. June 1943.

__________ - A fence post service test in the Mississippi Delta. Jour. Forestry 41 (7): 524-526. July 1943.

__________ - The preservative treatment of fence posts for southern farms. South. Lumberman 167 (2097): 65-66, 68. Aug. 15, 1943. South. Lumber Jour. 47 (8): 28, 66. Aug. 1943. The Arkansas Farmer 45 (9): 6-7. Sept. 1943. Published under title: "Fence posts for southern farms."

__________ - Integrated utilization in bottomland hardwoods. South. Lumberman 165 (2081): 193-194. Dec. 15, 1942. Summary in Delta Council News 4 (4): 3. Feb. 24, 1943.

Reynolds, R. R. - Employment requirements of well-managed timberland. South. Lumberman 167 (2105): 149-150, 152. Dec. 15, 1943.

Snow, A. G., Jr. - Review: Chemical gardening, by D. R. Matlin, vi + 159 pp., Chemical Pub. Co., Inc. 1942. Jour. Forestry 41 (1): 73. Jan. 1943.

__________ - Review: A handbook of plant tissue culture, by Philip R. White, 277 pp., The Jacques Cattell Press. 1943. Jour. Forestry 41 (12): 928. Dec. 1943.

__________, Dorman, K. W.; and Schopmeyer, C. S. - Breeding blue blood pines. The AT-FA Jour. 5 (6): 8-10. Mar. 1943.

__________, Dorman, K. W.; and Schopmeyer, C. S. - Developmental stages of female strobili in slash pine. Jour. Forestry 41 (12): 922-923. Dec. 1943.

Snyder, T. E., and Zetek, James - Effectiveness of wood preservatives in preventing attack by termites. U. S. Dept. Agr. Cir. 683. 24 pp. Sept. 1943.

Southern Forest Experiment Station - Instructions for the use of chemical stimulants to increase gum naval stores production in 1943, 8 pp. Mimeo. Mar. 6, 1943. The AT-FA Jour. 5 (6): 7, Mar. 1943. Naval Stores Rev. 52 (50): 8, 10, 12, Mar. 13, 1943.

—————— - Survey of the Little Tallahatchie Watershed in Mississippi. H. Doc. 892, 77th Cong., 2d sess. 74 pp. 1942.

Spillers, A. R., and Eldredge, I. F. - Georgia forest resources and industries. U. S. Dept. Agr. Misc. Pub. 501. 70 pp. 1943.

Verrall, Arthur F. - Fungi associated with certain ambrosia beetles. Jour. Agr. Res. 66 (3): 135-144. Feb. 1, 1943.

—————— - Sap stain chemicals for emergency use. South. Lumberman 166 (2085): 64-65. Feb. 15, 1943.

Winters, R. K.; Ward, G. B., Jr.; and Eldredge, I. F. - Louisiana forest resources and industries. U. S. Dept. Agr. Misc. Pub. 519. 44 pp. Aug. 1943.

UNPUBLISHED ADDRESSES

Bickford, C. A. - Controlled burning in relation to forest fire protection by State organizations in the South. Delivered before Fourth Annual Conference of State Fire Chiefs, Clear Fork Camp, Ouachita National Forest, May 25, 1943.

—————— - Methods of using fire and equipment that may be helpful. Planning the use of fire in forest protection. Delivered before Forest Farmers Association Cooperative conference on prescribed burning at Lake City, Fla., Dec. 14-16, 1943.

Muntz, H. H. - Forestry in the Delta. Delivered over WJPR, Greenville, Miss., July 7, 1943.